

***Diagnostic
Muscle
Testing
and an Introduction to
Muscle Therapies***



David Leaf



This book is designed to teach the basics of quality muscle testing to groups that are involved in physical medicine.

Other books have been done for years on this subject.

It was to add to this information that this book was done. I have taught muscle testing for over

40 years as part of applied kinesiology to doctors of chiropractic, medicine, osteopathy, and dentistry. This has given me the opportunity to see the struggle that many have in developing quality skills. Aside from my patient base, I have had the great opportunity to test and treat members of all of the major professional sports and Olympic athletes.

In biomechanical problems, you will have to test these muscles in various positions to uncover "hidden" problems. These tests will be covered in the following books along with the small muscles of the hand and foot.

Recently, I went to a primary care doctor who did muscle testing of the upper extremity that was so poor that all he could have found was a person with almost complete atrophy or had a stroke.

Learning muscle testing is an art and needs to be practiced so that you can use it on almost anyone.

The basics of the testing of individual muscles, their interrelationships with other muscles, and procedures to normalize function are covered.

Basic muscle testing has been around for decades. It has been advanced by members of the International College of Applied Kinesiology.

This book will be followed by others describing in detail how to correct musculoskeletal problems and will include not only what therapy is done in the office but also what treatment the injured person can do at home to speed recovery.

I have omitted the testing of the small muscles of the hands and foot. These will be covered in books on these subjects. The muscles of the head, especially the TMJ muscles will also be included in another book.

Future books are planned in the same format. I will be discussing the major problems encountered in the office. The discussion center more on the treatment and the home care that the patient can do to speed recovery.

The muscle section is followed by examples of using muscle testing to help diagnose peripheral nerve entrapments.

I have also included a short dissertation on what I call Functional Muscle Testing. This topic will be covered in future works but is added to give you an idea that the primary positions in muscle testing need to be adapted to the individual needs of the patient and what they do biomechanically.

The final part of the book contains short descriptions of traditional muscle therapies. As they will be discussed in greater detail in future books, I have included them to give you some necessary tools including when to use them.

I hope this book helps you with your patients. Remember, muscle testing is an art and takes dedication and time to become proficient. Don't get frustrated.

David Leaf, D.C. DIBAK

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Muscle Testing

History

Muscle testing is an essential tool that should be used in the physical examination. The basics of muscle testing were first established in the 1900's. The first system of muscle testing was developed at Harvard University Medical School and graded strength based on the ability to lift an extremity against gravity. The tests were designed to measure the effects of polio. In 1925 a resistance type of testing was described by H. S. Stewart, M.D. Kendall and Kendall published papers on manual muscle testing in the late '30's that formed the basis for the muscle testing techniques of today. They adapted the five-point system for grading muscle strength that had been in use since the 1920's. The first comprehensive textbook on muscle testing was published in 1946 by Daniels, Williams, and Worthingham. With the dramatic decline in polio cases, the 5 step grading system has been mostly abandoned.

Today most practitioners and therapists use a muscle test that has been described by the Institute of Sports Medicine and Athletic Trauma, as a "break test technique" method.

The basic concept of muscle testing is to challenge the ability of the muscle to adapt to increased stress after the patient has reached maximal contraction of the muscle. Muscle testing is an art as well as a science, and it takes time to become proficient in learning muscle testing. The rules are rather simple. Variations in the starting position will be discussed in future books.

1. For the standard test, approximate the origin and insertion of the muscle and place the body part in a position that minimizes other muscles that can contract to support or recruit during the contraction of the prime mover.
2. Supply adequate support to stabilize the person being tested so that they do not move or alter their position during the test.
3. Use a broad flat contact with the fleshy portions of your hands so that you do not cause pain or discomfort where you test or stabilize the patient.
4. The testing pressure is applied at a 90-degree angle to the arc of movement of the body part. Another way of saying this is that the pressure is applied at the tangent to the arc of the movement of the body part.
5. Try to keep your forearm in line with the vector of force.
6. If you are of small stature and testing a well-developed person, testing should be done using your weight and not your hand or forearm strength. The amount of force depends upon the relative strength and health of the person you are testing. In the test, you are checking the quality and ability of the muscle to "lock-up" the joint against the testing pressure.
7. Instruct the patient to apply pressure against your hand. When you feel the patient apply the pressure, increase your resistance against their pressure. When there is no increase in pressure, use an additional force in the testing direction. You are now testing the patient's ability to react to the extra force adapting their neuromuscular system as in a challenge mechanism. Alternatively, ask the patient to push in a specific direction when you say "hold." Apply light pressure in the specific vector and when you feel the patient pushing back appropriately, increase your pressure until you feel a firm "lock" or the muscle test fails. Always be careful not to overpower the patient.

For simplicity, the terms weak and strong are used at times instead of the correct terms inhibition or inhibited muscle and facilitation or facilitated muscle.

Accurate muscle testing is a skill which must be developed through practice.

The tester's ability to feel the quality of resistance is more important than whether a limb can be forced from the testing position.

A strong, regular functioning, muscle tends to feel the same to the tester regardless of the age or size of the patient. You do not measure pounds or kilograms of force.

The test is not a contest, and there should never be an attempt to overpower the patient. This could damage the muscle being tested and possibly the joint.

Always test the same, never change the vector of the testing force or your hand contacts.

The patient must be stabilized so that recruitment of other muscles is avoided. Make sure you do not contact bony prominences or press too hard.

Observe for changes in the tester's extremity or body positioning. Do they bend, rotate or otherwise change the positioning of the body part. This indicates a need for the patient to recruit other muscles to support the muscle being tested.

Always talk to the patient giving them directions of where and when to push.

Always start with a light force until you feel the patient applying counter pressure against your hand and then steadily not abruptly increase your testing pressure.

The standard muscle testing grading system gives 5 levels of muscle response.

Grade 0: Full paralysis

Grade 1: Slight muscle response fasciculation observed

Grade 2: Patient cannot move limb but not against gravity

Grade 3: Limb moves against gravity but fails against minimal pressure

Grade 4: Patient can withstand moderate to strong testing pressure but gives or feels "spongy."

Grade 5: Muscle has average strength and can lock and not give under strong testing pressure.

In general practice, we are dealing with grades 3 - 5.

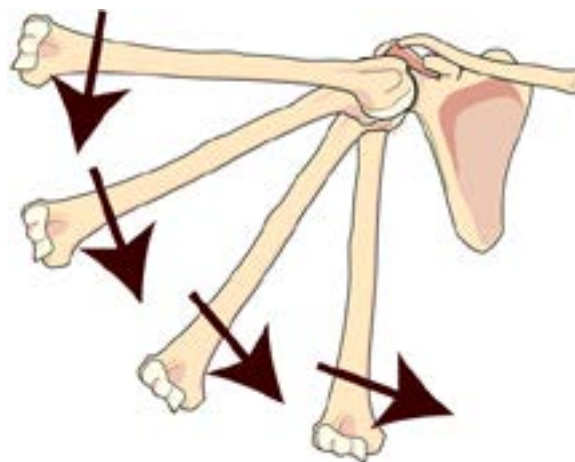


The top picture shows the standard starting position for testing of the middle section of the deltoid muscle.

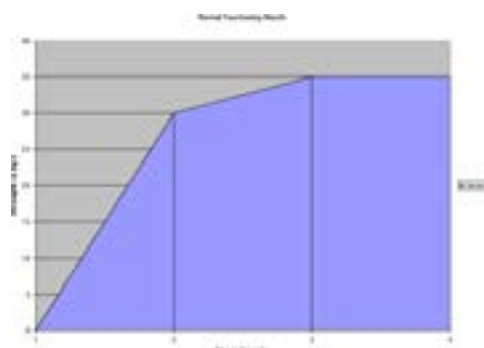
Stabilization is given to the shoulder. A broad contact is used. Recruitment usually begins as a change in the angle of the joint or rotation of the humerus. The stabilizing hand can detect these changes.

The soft portion of the hand is applied to the elbow region taking care to avoid contacting the epicondyle.

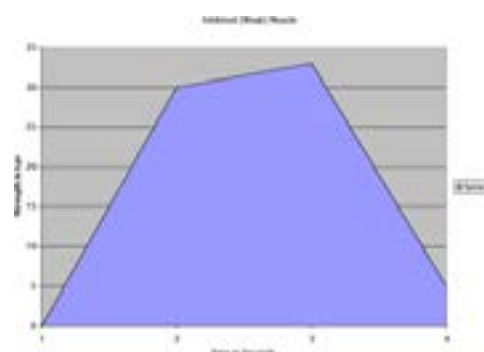
The angle of the test can be varied along the arc of the motion of the humerus.



The graph to the right shows the normal response to muscle testing. Pressure is applied and resistance given until you reach a maximum level. Additional stress is then applied and the patient is able to adapt to that stress.



The lower graph shows failure to adapt to the additional stress. The part being tested appears to "break away" thus the name Break Test.



Scalenes

Origin

Scalenus Anticus: Ant. tubercles of transverses C 2 - 6

Scalenus Medius: Post. tubercles&transverses C 2- 7

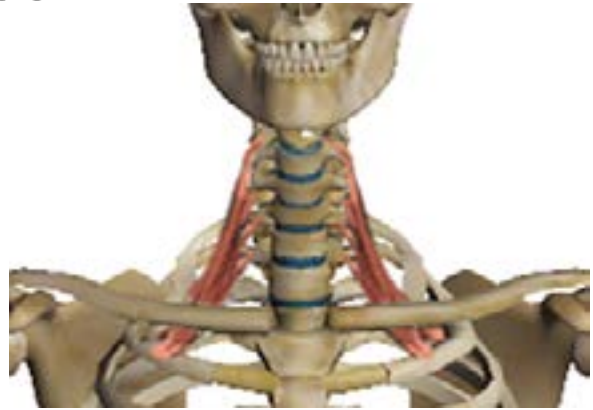
Scalenus Posticus: Post. tubercles&transverses C 4-6

Insertion

Scalenus Anticus: Scalene tubercle and the superior surface first rib

Scalenus Medius: Superior surface first rib

Scalenus Posticus: Outer surface second rib



Action

Jointly, these muscles flex the cervical spine and indirectly the head. Unilaterally, they cause rotation and lateral flexion of the neck. The scalenus anticus and the medius elevate the first rib anteriorly while the posticus does the same to the second rib.



Position of body part

The subject is lying supine. The neck is flexed and then the head is flexed on the neck. To test both sides, the head is kept in a neutral position. To isolate each side, the head is rotated 10 degrees left and right.



Stabilization

The subject's arms are flexed above 90 degrees to limit recruitment. The non-testing hand is placed behind the head to catch it in case of weakness.

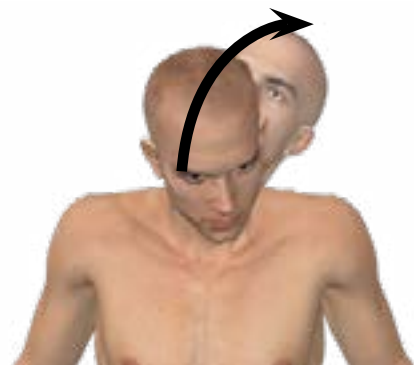


Contact

Contact is made over the frontal bone. A broad contact is used when testing both sides. When the sides are isolated by rotating the head, the knife side of the hand is used.

Vector of Force

Pressure is applied against the head at a tangent to the arc created by the motion of the head and neck as they are flexed.



Nerve Supply Anterior C 5- 8
Middle C 3- 4 Posterior C 3- 8

Synergists

Flexion: Parts are synergistic with each other, sternocleidomastoid
Rotation: Upper trapezius, neck extensors
Chest elevation: Sternocleidomastoid

Antagonists

Flexion: Neck extensors, upper trapezius
Rotation: Upper trapezius, neck extensors
Chest elevation: Pectoralis clavicular

Signs of inhibition

When the muscles are inhibited unilaterally, there will be slight head rotation. The patient will complain of difficulty raising the head from a supine position.

Strain counterstrain

Rotate the neck 10 degrees away from the side of the muscle involved and then flex the neck. Rotate slightly to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

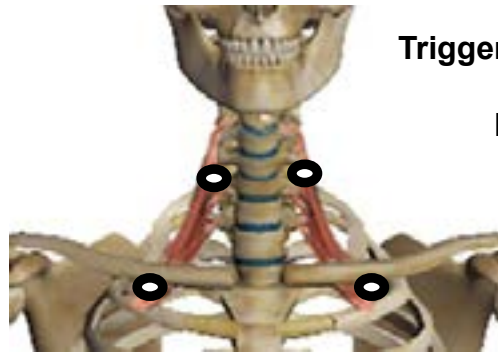
The patient will either rotate the head further to recruit the sternocleidomastoid or towards the opposite side to recruit the opposite scalene muscles.

Comments

If the extensors are inhibited, the scalenes become shortened and neurovascular symptoms increase.

Trigger Points

Referred Pain



Common Recruitment

Sternocleidomastoid

Origin

Sternal head: Manubrium over the anterior surface
Clavicular head: Superior surface of the medial half of the clavicle

Insertion

Into the lateral surface of the mastoid process and the lateral half of the superior nuchal line of the occiput.



Action

Jointly, the sternocleidomastoid when contracted bilaterally flexes the head on the neck and aids in cervical flexion. Unilaterally, contraction rotates the head to the opposite side. It aids in lateral bending of the cervical spine. Aid in elevation of the rib cage.

Position of body part

The subject is lying supine or sitting. The neck is flexed and then the head is flexed on the neck. The head and neck are then fully rotated.



Stabilization

The subject's arms are flexed above 90 degrees to limit recruitment. The non-testing hand is placed behind the head to catch it in case of weakness.



Contact

Contact is made over the parietal bone. A broad contact is used.

Vector of Force

Pressure is applied against the head at a tangent to the arc created by the motion of the head.



Nerve Supply Spinal Accessory (Cranial 11)
Anterior rami of C - 2 & 3.

Synergists

Flexion: Bilaterally synergistic with each other, neck flexors
Rotation: Upper trapezius, scalenes
Chest elevation: Scalenes

Antagonists

Flexion: Neck extensors, upper trapezius
Rotation: Opposite sternocleidomastoid, upper trapezius, neck extensors
Chest elevation: Pectoralis clavicular

Signs of inhibition

Head rotation towards the side of inhibition

Strain counterstrain

Flex the head on the neck and then rotate the neck 45 degrees followed by flexion towards the muscle involved.

Common Recruitment - Testing Errors

An attempt to derotate the head will be done to recruit the scalenes.

Comments

If inhibited, suspect instability of the head of the clavicle.

Trigger Points

Referred Pain



Common Recruitment

Neck Extensors

Short extensors

Origin

Splenius capitis:	Spinouses C - 7 to T 3
Splenius cervicis:	Spinouses of T - 3 to 6
Semispinalis capitis:	Transverses C - 4 to T - 6
Semispinalis cervicis:	Transverses T - 1 to T - 6

Insertion

Splenius capitis:	Mastoid & lateral nuchal line
Splenius cervicis:	Transverses C - 1 to C - 4
Semispinalis capitis:	Between the superior and inferior nuchal lines
Semispinalis cervicis:	Spinouses of C - 2 to 5

Action

Jointly, these muscles extend the cervical spine and the head. Unilaterally, they cause rotation and lateral flexion of the neck.



Long extensors



Position of body part

The subject is lying prone. The neck is extended and then the head is extended on the neck. To test both sides, the head is kept in a neutral position. To isolate each side, the head is rotated fully left and right. To isolate the short and long extensors, test sitting. For the longs, extend the neck and for the shorts, only the head on the neck.

Stabilization

The subject's arms are flexed above 90 degrees to limit recruitment. The non-testing hand is placed in front of the head to catch it in case of weakness.



Contact

Contact is made over the occipital bone. A broad contact is used.

Vector of Force

Pressure is applied against the head at a tangent to the arc created by the motion of the head and neck as they are extended.



Long extensors

Nerve Supply C - 4 - T - 6

Synergists

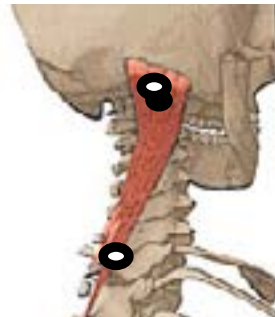
Extension: Parts are synergistic, upper trapezius, levator scapula
Rotation: Upper trapezius, scalenes, sternocleidomastoid

Antagonists

Extension: Sternocleidomastoid, scalenes
Rotation: Upper trapezius, sternocleidomastoid, scalenes, opposite neck extensors



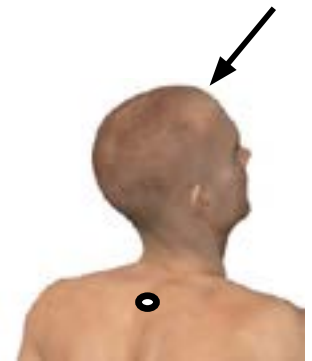
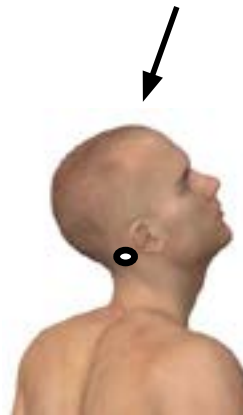
**Trigger Points
Referred Pain**



Signs of inhibition

Bilaterally, the head is carried in a forward position with the external acoustic meatus anterior to the center of the shoulder.

Unilateral weakness will cause slight head elevation and rotation of the head.



Strain counterstrain

For the short extensors, stabilize the neck and extend and rotate the head until the tender point decreases maximally. For the long extensors, stabilize the head and bring the neck into extension and then rotate until the tender point decreases.

Common Recruitment - Testing Errors

When testing the long extensors, extending the head on the neck or laterally bending the neck recruits the upper trapezius..

Pulling on the skin of the scalp.

Using fingers of the testing hand

Comments

If you look from the side, the external acoustic meatus should be centered on the shoulder. If it is anterior of the shoulder, the neck extensors are inhibited. One of the common causes of this inhibition is the inhibition created by hypertonic plantar muscles. In this case, the neck extensors will be inhibited weight bearing and strong with the patient non-weight bearing.



Common Recruitment

Upper Trapezius

Origin

Arises from the external occipital protuberance, the medial 1/3 of the superior nuchal line, ligamentum nuchae and the spinous of C - 7



Insertion

Into the acromion process and the lateral 1/3 of the clavicle.

Action

Elevates the shoulder. Rotates the scapula so that the glenoid cavity faces in a superior direction. Lateral flexion of the head and neck and aids in cervical and neck extension.



Position of body part

The subject is asked to elevate the shoulder and then to bring the ear towards the shoulder. Rotate the head 20 degrees opposite the elevated shoulder.

Stabilization

The hand is placed over the elevated shoulder. To test the muscle stand on the side opposite the test.

Contact

Reach over the top of the head and grasp the side of the skull.

Vector of Force

Pressure is directed as to pull the head away from the elevated shoulder. Leverage is gained by standing on the side opposite the muscle being tested.



Nerve Supply C - 2, 3 & 4 and the spinal accessory nerve.

Synergists

Shoulder elevation: Levator scapula
Neck/ head motions: Sternocleidomastoid
Arm Abduction: Deltoid, supraspinatus

Antagonists

Shoulder elevation: Latissimus dorsi
Neck/ head motions: Sternocleidomastoid
Arm Abduction: Latissimus, subscapularis

Signs of inhibition

In the standing position, the person will have a dropping of the shoulder on the side of weakness. If weak bilaterally, the head will appear to be forward of the thoracic cage.

Strain counterstrain

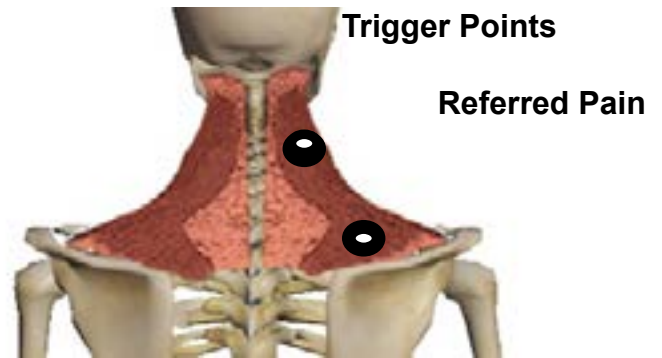
The head is rotated away from the muscle being treated. The neck is then laterally flexed bringing the ear towards the shoulder.

Common Recruitment - Testing Errors

Rotation of the head towards the side being tested to recruit the scalenes
Using a horizontal vector for testing
Pulling the skin of the scalp

Comments

Extreme tenderness and contraction in the muscle is frequently caused by stretching of the acromioclavicular ligament



Common Recruitment

Subclavius

Origin

Arises from the first rib at its junction with the costal cartilage



Insertion

Inserts into a groove on the posterior surface of the clavicle

Action

Draws the clavicle inferior and anterior.
Assists in protraction of the clavicle.



Position of body part

With the elbow extended, raise the arm so that it approximates the head.

Stabilization

Contact the shoulder and give firm support. Your fingers should extend over to contact the clavicle. You will be feeling for any movement of the head of the clavicle.



Contact

Grasp the forearm proximal to the wrist.

Vector of Force

The testing force is applied at 90 degrees to the arm as to pull the arm away from the head



Nerve Supply C - 5 & 6

Synergists

Clavicle stability: Pectoralis clavicular

Antagonists

Clavicle stability: Sternocleidomastoid

Signs of inhibition

Excessive motion of the head of the clavicle
Acromioclavicular strains

Strain counterstrain

Palpate the area of tenderness and bring the humerus across the chest almost horizontal. Apply pressure against the scapula to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

Bending of the elbow to recruit the bicep.
Make sure to contact the head of the clavicle to monitor for motion if the muscle is inhibited.

Comments

The muscle is involved in motions of the shoulder. Inhibition causes a decreased range of motion of the shoulder. The subject will complain of discomfort when the arm is raised or any force is applied to the shoulder with the arm elevated or the arm is brought behind them as in putting something in a back pants pocket or attaching a bra.



Trigger Points

Referred Pain



Common Recruitment

Serratus Anterior

Origin

Arises from the lateral and superior surfaces of the upper nine ribs.

Insertion

Inserts into the costal surface of the vertebral border of the scapula from the superior angle to the inferior angle.

Action

Stabilizes the scapula during flexion and abduction. The lower fibers rotate the scapula around the glenoid fossa. Contraction aids in protraction and elevation of the scapula and in keeping the medial border firmly against the chest wall as in doing a push-up.

Position of body part

The elbow is extended and the arm is flexed between 100 to 160 degrees and abducted 30 degrees. To isolate the various attachments on the rib cage, the arm should be tested at 100, 130 and 160 degrees of flexion.

Stabilization

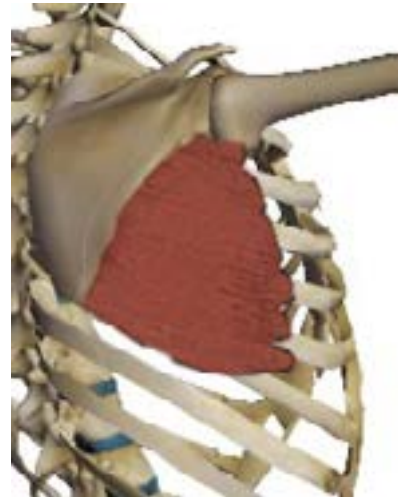
The inferior angle of the scapula is cupped with the thumb and the index finger. These are used to feel for any motion of the scapula that occurs during the test.

Contact

Contact over the lower arm just superior to the wrist. Care is used to avoid any bony contacts.

Vector of Force

Pressure is applied against the forearm in an inferior direction. Movement is felt for at the inferior angle of the scapula.



Nerve Supply

Upper fibers - C - 5
Middle C - 5 & 6,
Lowest C - 6 & 7.

Synergists

Scapula protraction: Pectoralis major and minor
Elevation: Upper trapezius

Antagonists

Scapula protraction: Rhomboid, middle trapezius
horizontal fibers of latissimus
Elevation: Vertical fibers of latissimus,
pectoralis muscles

Signs of inhibition

Elevation of the shoulder during abduction of the arm.
The inferior angle of the scapula rotates under the axilla with flexion of the arm.
Winging of the scapula.
Acromioclavicular injuries.
Contraction, pain or ache in the upper trapezius.

Strain counterstrain

Palpate along the ribs to find the area of tenderness.
Contact the scapula with the thumb along the vertebral border and the index finger along the spine of the scapula. Apply pressure against the scapula towards the palpated pain area to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

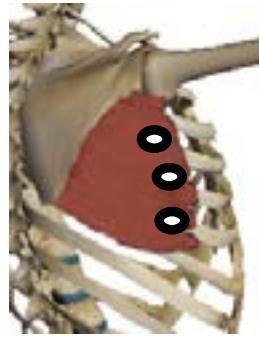
Flexion of the elbow..

Failure to monitor the stability of the scapula. In inhibition, the scapula will rotate with the inferior angle moving laterally towards the mid axillary line.

Comments

The arm should be tested at varying angles of flexion to isolate the various fibers of the muscle. Along with the subclavius, these are the two muscles that are frequently overlooked in shoulder problems.

Any weakness in the humeral head stabilizing muscles, especially the anterior deltoid will result in the inability to test this muscle. This is a muscle that depends on intact shoulder muscles and stability of the elbow for proper testing.



Trigger Points

Referred Pain



Common Recruitment

Deltoids

Origin

Anterior: Lateral 1/3 of the clavicle
 Middle: Acromion process
 Posterior: Lateral aspect of the spine of the scapula

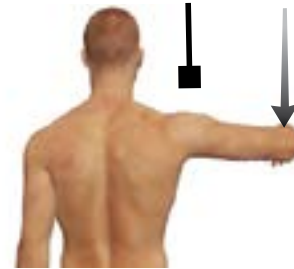
Insertion

Into the deltoid tubercle of the humerus.



Action

Abduction of the humerus. The anterior and posterior portions aid in flexion and extension respectively. The anterior and posterior sections can function synergistically with each other or in an antagonistic fashion.



Position of body part

The arm is abducted 90 degrees and the elbow is flexed. For the anterior section the humerus is rotated externally 45 degrees and then flexed 20 degrees. For the posterior, the humerus is placed in 45 degrees internal rotation and 15 degrees extension.



Stabilization

The hand is placed over the shoulder joint. This prevents any elevation of the shoulder during the test.



Contact

Contact the elbow just superior to the epicondyle for the middle section, on the anterior aspect for the anterior and over the posterior aspect for the posterior section.

Vector of Force

Middle: In the direction of adduction
 Anterior: Posterior inferior along forearm
 Posterior: Anterior inferior along forearm



Nerve Supply C - 5

Synergists

Humerus abduction: Supraspinatus, subscapularis, upper trapezius
Humerus extension: Infraspinatus, latissimus
Humerus flexion: Pectoralis minor and sternal

Antagonists

Humerus abduction: Pectoralis, latissimus, subscapularis
Humerus extension: Anterior deltoid, pectoralis minor
Humerus flexion: Posterior deltoid, latissimus

Signs of inhibition

Inhibition of either the anterior or posterior sections will result in slight shifting of the shoulder away from the inhibited section of the muscle.

Strain counterstrain

Start with the muscle test position and then elevate and slightly rotate the humerus to find the position of the greatest reduction in pain.

Common Recruitment - Testing Errors

Allowing the shoulder to be elevated prior or during the test.

Not moving the humerus into flexion or extension to test the anterior or posterior fibers.

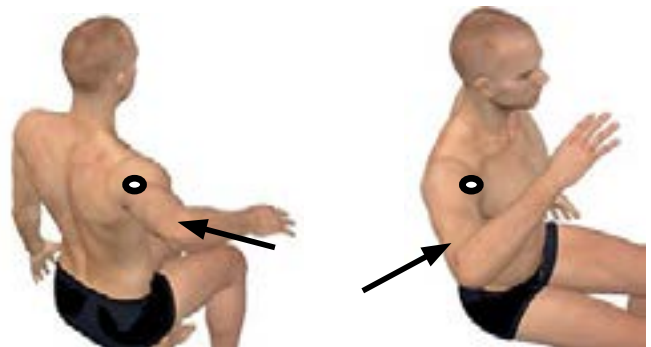
Comments

Injuries to the deltoid, especially the middle and posterior segments cause instability of the acromioclavicular joint. Any injury to the ligament at the acromioclavicular joint will also cause an inhibition of the deltoid. The posterior portion is the most commonly found.

Shortening of the deltoid may cause the humerus to become entrapped limiting abduction of the arm.

Trigger Points

Referred Pain



Common Recruitment

Teres Major

Origin

Arises on the scapula from an oval area starting near the inferior angle running up the lower 1/3 of the axillary border.

Insertion

Inserts into the lesser tubercle of the humerus along with the fibers of the latissimus dorsi

Action

The teres major assists in internal rotation, adduction and extension of the humerus.

Position of body part

The elbow is flexed to 90 degrees and the arm is internally rotated. The dorsal surface of the hand is placed over the posterior iliac crest. The arm is then maximally extended.

Stabilization

If testing the muscle unilaterally, pressure is applied over the opposite rib cage. In bilateral testing the opposing muscle test serves as the stabilization.

Contact

Contact over the arm by the elbow. If testing the muscle bilaterally, cross your arms contacting the right elbow with your left hand and the left elbow with the right hand and the testing angles will be correct.

Vector of Force

Pressure is applied against the elbow in a direction of abduction and flexion.



Nerve Supply C - 5 & 6. (Lower scapular nerve)

Synergists

Humerus extension: Latissimus, long head of triceps, posterior deltoid
Internal rotation: Latissimus, long head of triceps, subscapularis

Antagonists

Humerus extension: Pectoralis muscles, anterior deltoid
Internal rotation: Teres minor, infraspinatus

Signs of inhibition

In the standing posture, it is one of the muscles that can cause the arm to rotate so that the palm is facing forward.
Instability of the humerus when the arm is internally rotated.

Strain counterstrain

Palpate the trigger point pain and place the arm in the testing position. Apply pressure against the humerus to approximate the origin and insertion of the muscle to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

Failure to fully extend the humerus into the test position. Improper angle of the testing force. (More lateral than anterior.)

Applying pressure over the medial epicondyle.

Allowing the person to extend the elbow allowing recruitment

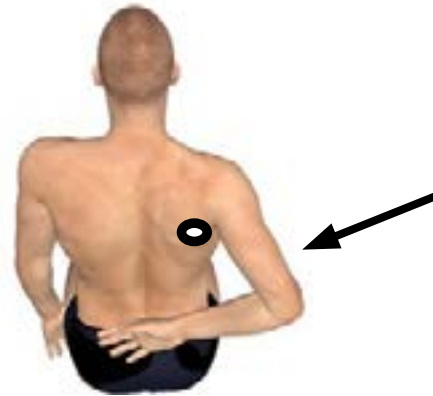
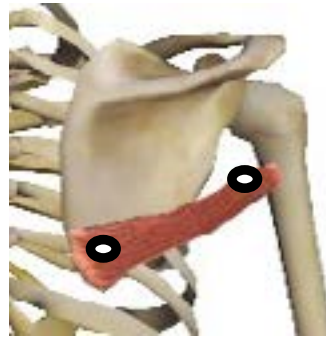
Comments

Although often found inhibited, the muscle is often found over contracted causing reflex inhibition in the deltoids or other antagonistic muscles. This pattern causes men to be unable to reach into their back pockets or women to fasten their bra behind their back.

Pain is usually exacerbated by forced motions with the arm in a flexed position. These could include turning a steering wheel in a car or in the throwing motion or in painting a wall.

Trigger Points

Referred Pain



Common Recruitment

Teres Minor

Origin

Arises from the medial one third of the axillary border of the scapula on the dorsal surface.

Insertion

Into the most inferior aspect of the greater tuberosity of the humerus.



Action

Contraction of the teres minor causes external rotation of the humerus in the glenoid cavity. The muscle also aids in the stabilization of the head of the humerus in the glenoid cavity. In this regard, the muscle contracts throughout the stages of arm flexion and abduction.

Position of body part

The elbow flexed 90 degrees and the humerus is rotated externally after being placed into at least 30 degrees abduction. A simple way to position the patient is to bend the elbow at 90 degrees and place the their palm over the umbilicus. Externally rotate the humerus by bringing the hand away from the abdomen while stabilizing the elbow.



Stabilization

The elbow is supported with a broad contact making sure that no pressure is applied to the epicondyles.



Contact

A broad contact is made against the posterior aspect of the distal forearm.

Vector of Force

Pressure is applied at a tangent of the arc created rotating the humerus.



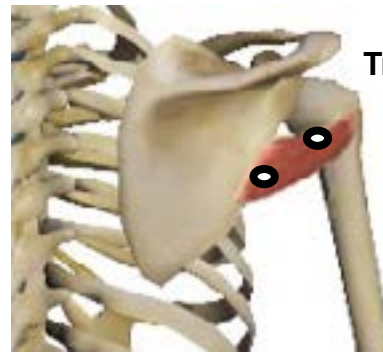
Nerve Supply C - 5, 6 & 7

Synergists

Humeral stabilization: Infraspinatus, supraspinatus, subscapularis (rotator cuff)
External rotation: Post. deltoid, infraspinatus
Adduction: Subscapularis, teres major, latissimus

Antagonists

External rotation: Subscapularis, teres major



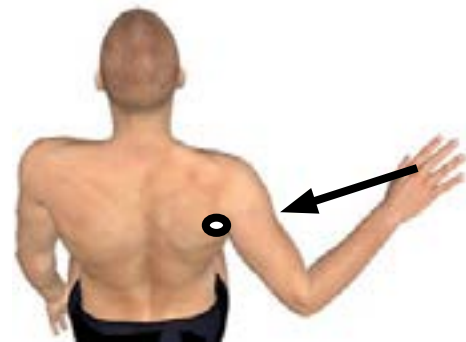
Trigger Points

Referred Pain



Signs of inhibition

When viewed from the posterior, the humerus is rotated internally and the palm will face posterior.



Strain counterstrain

Palpate the trigger point pain and place the arm in the testing position. Apply pressure against the humerus to approximate the origin and insertion of the muscle to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

Failure to abduct the arm.

Allowing the patient to recruit by changing the angle of the elbow to a either an angle greater or less than 90 degrees.

Allowing the subject to extend the hand/wrist

Comments

Inhibition causes excess stress in tennis when performing a backhand stroke



Common Recruitment

Infraspinatus

Origin

Medial two-thirds of the infraspinous fossa inferior to the spine of the scapula.

Insertion

Posterior aspect of the greater tuberosity of the humerus and to the shoulder joint capsule



Action

Externally rotates the arm along with the teres minor. Along with the other muscles of the rotator cuff, it stabilizes the head of the humerus in the glenoid cavity while the arm is elevated. The superior and inferior fibers can act independently. The superior fibers aid in abduction and the inferior fibers in adduction.

Position of body part

The elbow is flexed at 90 degrees. The general test has the humerus abducted to 90 degrees. The humerus is then maximally rotated externally. Varying the angle below 90 degrees will test the inferior fibers of the muscle while raising the humerus above 90 degrees test the more superior fibers of the muscle.



Stabilization

The elbow is supported with care taken to avoid bony contacts over the epicondyles.

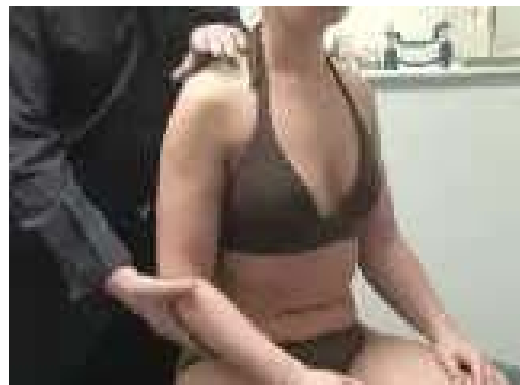


Contact

Contact is made over the lower forearm superior to the wrist on the posterior aspect. Avoid any bony contacts.

Vector of Force

Pressure is applied against the lower forearm as to rotate the humerus. The vector of force is at a tangent made by rotating the humerus in the glenoid cavity with the elbow supported in a stationary position.



Nerve Supply C - 5 & 6

Synergists

Humeral stability: Teres Minor, supraspinatus and subscapularis (rotator cuff)
Ext. humeral rotation Teres minor and posterior deltoid

Antagonists

Humeral rotation: Anterior deltoid, pectoralis major
Adduction/abduction: Superior and inferior fibers of the muscle may act antagonistically

Signs of inhibition

Standing, the arm will hang with the humerus internally rotated. Atrophy of the muscle is easily palpated or observed. Palpation of the humeral head will find it protruded.

Strain counterstrain

Palpate the trigger point pain and place the arm in the testing position with the arm extended. Move the humerus superior and inferior to find the greatest reduction in tenderness. The more inferior the trigger point the more the humerus will need to be elevated.

Common Recruitment - Testing Errors

Letting the patient vary the angle of the elbow.
Not fully rotating the humerus to the limit of the natural external range of motion.
Observe the patient for a change in the position of the glenoid cavity due to recruitment.

Comments

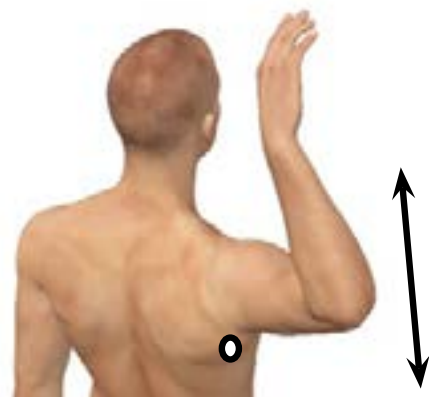
The infraspinatus should have the angle of the test altered to isolate segments of the muscle. This is done by altering the degree of abduction of the humerus between 70 and 130 degrees.

If inhibited, this muscle will cause a reflex hypertonicity of the subscapularis. The muscle may test inhibited due to entrapment of the suprascapular nerve.



Trigger Points

Referred Pain



Common Recruitment

Subscapularis

Origin

Arises from almost the total inner surface of the scapula.

Insertion

Attaches on the anterior surface of the humerus at the lesser tubercle and on the inferior portion of the shoulder joint capsule.

Action

The subscapularis is the major internal rotator of the humerus.

It also assists in humus adduction. Its contraction during arm abduction stabilizes the humeral head in the glenoid cavity.

Position of body part

Bring the arm to 90 degrees abduction and then flex the elbow 90 degrees. Then rotate the arm internally to its limit without protrusion of the shoulder

Stabilization

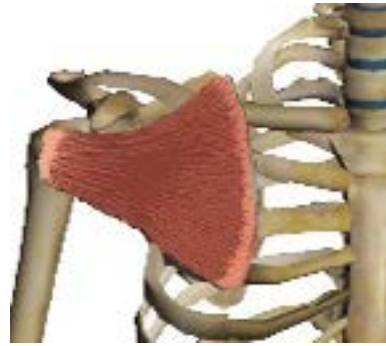
Contact the elbow to keep the humerus at 90 degrees abduction. The rhomboids and the middle trapezius muscles fix the scapula on the chest wall during the test.

Contact

Contact the lower forearm just above the wrist. Avoid the wrist itself.

Vector of Force

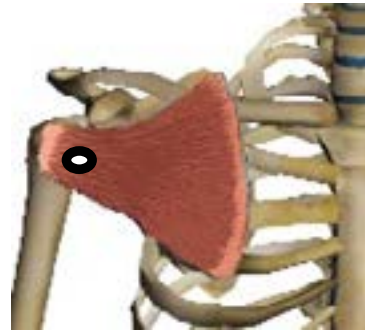
Pressure is applied against the forearm to externally rotate the humerus.



Nerve Supply C -5 & 6

Synergists

Humerus adduction: Pectoralis major, teres major
Internal rotation: Latissimus, pectoralis, teres major



Trigger Points

Referred Pain

Antagonists

Humerus adduction: Deltoid, supraspinatus
Internal rotation: Teres minor, infraspinatus

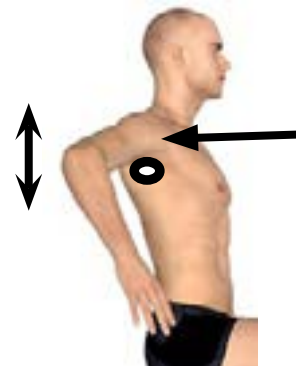
Signs of inhibition

In the standing posture, it is one of the muscles that can cause the arm to rotate so that the palm is facing forward.



Strain counterstrain

The arm is placed in the testing position and the shoulder is brought into extension. The angle of the humerus is raised or lowered until the greatest reduction in pain is found



Common Recruitment - Testing Errors

If tested supine or sitting, allowing the patient to elevate the shoulder during the test. Failure to fully internally rotate the humerus allows recruitment of the other synergistic muscles.

Testing against the hand causes facilitation.

Comments

The subscapularis is one of the critical muscles in frozen shoulder cases.

Changes in the subscapularis begin the pattern of decreased abduction and external rotation. These changes are initiated by an inhibition in the prime movers of abduction and/or external rotation that then fail to initiate the proper inhibition of the subscapularis. The muscle is often found to be shortened and hypertonic.



Common Recruitment

Supraspinatus

Origin

Medial two-thirds of the supraspinatus fossa.



Insertion

Superior aspect of the greater tubercle of the humerus.



Action

Abducts the humerus holding the head of the humerus into the glenoid fossa. The supraspinatus functions during the swinging of the arm in normal walking. The supraspinatus becomes inhibited when the arm is at the end of flexion and extension when walking or running.

Position of body part

Keep the arm in the anatomical position with the elbow in full extension. Abduct the arm 25 degrees.



Stabilization

Place the hand over the acromioclavicular joint. This allows you to feel any aberrant motion in the shoulder during the muscle test.

Contact

Grasp the forearm above the wrist with a broad contact.



Vector of Force

Apply pressure at a tangent to the arc created by the natural swing of the arm in abduction. The direction will be slightly from anterior to posterior.



To test for impingement, raise the arm to at least 150 degrees. Inhibition strongly indicates impingement of the tendon of the muscle.

Testing for impingement of the tendon of the supraspinatus

Nerve Supply C - 4 & 5

Synergists

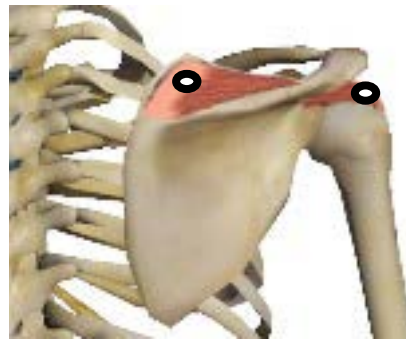
Arm abduction: Middle deltoid, upper trapezius.
(Serratus anterior for proper scapula stabilization)

Humeral stabilization: Infraspinatus, teres minor, subscapularis

Antagonists

Arm abduction: Latissimus dorsi, teres major and minor.

The subscapularis and infraspinatus may act as antagonists.



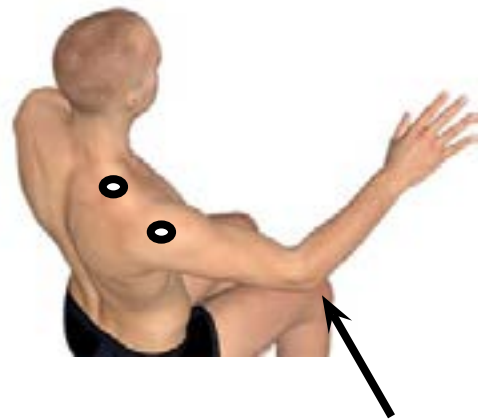
Trigger Points

Referred Pain



Signs of inhibition

If extremely weak, the patient will laterally bend the torso to initiate abduction of the arm.



Strain counterstrain

Palpate for the area of tenderness. Bring the arm slightly anterior and then elevate the humerus palpating for a reduction in tenderness. Do not internally or externally rotate the humerus

Common Recruitment - Testing Errors

The most common recruitment is flexing of the elbow to recruit the biceps. Also, watch for change in hand position especially radial deviation.

Comments

The supraspinatus is responsible for holding the humeral head in the glenoid cavity. It never fully relaxes.

It is basically responsible for the initiation of arm abduction. In coordination with the deltoid, they are the prime movers of abduction. During abduction, the subscapularis contracts to hold the humeral head in the glenoid cavity. Muscular imbalances between the deltoid, supraspinatus and the subscapularis are very common.



Common Recruitment

Pectoralis Clavicular

Origin

Arises from the medial half of the anterior surface of the clavicle.

Insertion

Into the crest of the greater tubercle of the humerus along the lateral lip of the bicipital groove.



Action

Flexes the shoulder joint. Draws the humerus across the chest. Assists in flexion of the humerus.



Position of body part

The arm is flexed to 90 degrees with the elbow extended. The arm is internally rotated so that the palm is facing away from the body.



Stabilization

The hand is placed over the opposite shoulder. If testing the muscle bilaterally, one side stabilizes the opposite side.



Contact

Contact is made on the lower arm superior to the wrist.

Vector of Force

Pressure is directed laterally and slightly inferiorly. If straight lateral is considered to be 90 degrees, the test angle would be at 80 degrees.



Nerve Supply C - 5, 6 & 7

Synergists

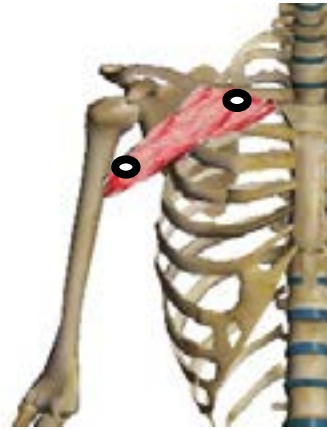
Humerus adduction: Pectoralis sternal, pectoralis minor, teres major, teres minor, anterior & posterior deltoid

Shoulder flexion: Anterior deltoid, coracobrachialis, subclavius

Antagonists

Clavicle motion: Posterior deltoid, middle trapezius

Humerus adduction: Latissimus



Trigger Points

Referred Pain



Signs of inhibition

Retraction of the scapula.

The shoulder will appear to be posterior.



Strain counterstrain

The muscle is palpated for the area of tenderness. The humerus is then drawn over the chest so that the arm is slightly inferior to the clavicle.. The scapula is then pulled or pushed slightly anterior.

Common Recruitment - Testing Errors

The most common recruitment is bending of the elbow to utilize the biceps. Another change is to derotate the arm.

Comments

Palpation of the pectoralis clavicular frequently reveals trigger points of the strain counterstrain pattern. These may be found over the attachment on the humerus. Note that the clavicular portion inserts inferior to the fibers of the sternal section.



Common Recruitment

Pectoralis Sternal

Origin

Arises from the lateral aspect of the sternum, cartilages of the second to the 7th ribs and by aponeurosis to the external abdominal oblique and the rectus abdominus muscle.

Insertion

Into the crest of the greater tubercle of the humerus along the lateral lip of the bicipital groove.

Action

Flexes the shoulder joint. Adducts the humerus across the chest so that the arm is brought towards the opposite anterior superior iliac spine. Assists in flexion of the humerus.

Position of body part

The arm is flexed to 90 degrees with the elbow extended. The arm is internally rotated so that the palm is facing away from the body.

Stabilization

The hand is placed over the opposite thigh inferior to the anterior superior iliac spine. Pressure against the pelvis can cause discomfort and result in the patient failing to resist during the test..

Contact

Contact is made on the lower arm superior to the wrist.

Vector of Force

Pressure is directed lateral and superior. If straight lateral is considered to be 90 degrees, the test angle would be at 130 degrees. However, in cases of injury to the muscle is suspected, the angle of the test should be changed to isolate that section of the muscle.



Nerve Supply C - 6, 7 & 8; T - 1

Synergists

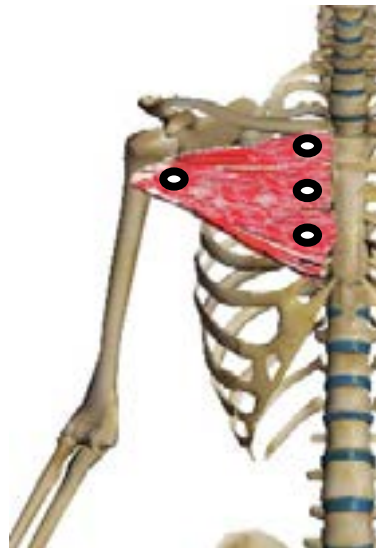
Humerus adduction: Pectoralis clavicular and pectoralis minor, teres major, teres minor, anterior deltoid, posterior deltoid

Shoulder depression: Latissimus, lower trapezius

Antagonists

Humerus adduction: Deltoid, supraspinatus

Shoulder depression: Upper trapezius



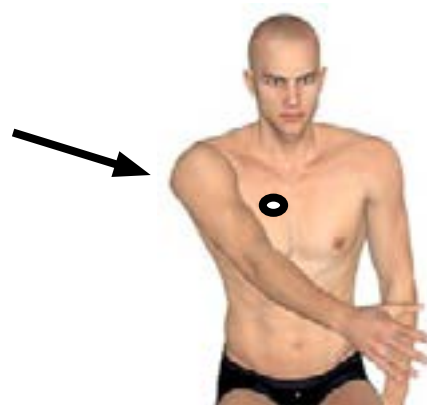
Trigger Points

Referred Pain



Signs of inhibition

Retraction of the scapula. The shoulder will appear to be posterior and slightly superior.



Strain counterstrain

The muscle is palpated for the area of tenderness. The humerus is then drawn over the chest so that the arm is placed over the area being palpated. The scapula is then pulled or pushed slightly anterior

Common Recruitment - Testing Errors

The most common recruitment is bending of the elbow to utilize the biceps. Another change is to derotate the arm.

Comments

Injury to a section of the muscle at its origin on the chest cage is frequently misdiagnosed. Persons suspected of inflammation of the costal cartilages should be examined by varying the angle of the test to isolate the fibers that arise from this area. Treatment would then be either the trigger point therapy of Travell or the strain counterstrain procedure of Jones.



Common Recruitment

Pectoralis Minor

Origin

Arises from the third, fourth and fifth ribs near the junction of the rib and its costal cartilage.

Insertion

Into the coracoid process of the scapula.



Action

Flexion and adduction of the shoulder joint.
Draws the scapula anterior, and inferior. By itself it can cause winging of the scapula.
Contraction also aids in forced inspiration.



Position of body part

The arm is adducted with the elbow extended. The arm is placed directly over the fibers of the pectoralis minor (towards the opposite anterior superior iliac spine). The arm is then externally rotated.

Stabilization

The hand is placed over the shoulder being tested.

Contact

Contact is made on the posterior aspect of the arm in the area of the elbow. If there is pain in this location, place your hand just superior to the elbow.

Vector of Force

Pressure is directed to elevate (abduct) the arm up off of the body in the line of the muscle fibers.

A more general test is to elevate - protract the shoulder and press in a lateral and posterior direction.



Kendall and Kendall original general test



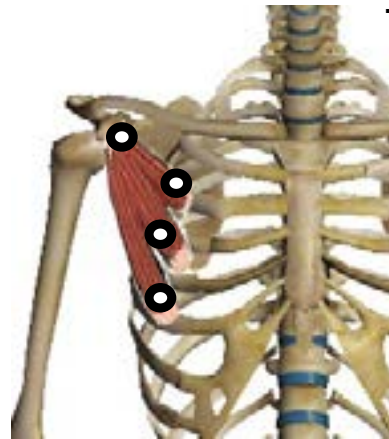
Nerve Supply C - 6, 7 & 8

Synergists

Forced Inspiration: Levator scapula, upper trapezius, sternocleidomastoid, scalenes,
Shoulder depression: Pectoralis sternal

Antagonists

Shoulder depression: Upper trapezius



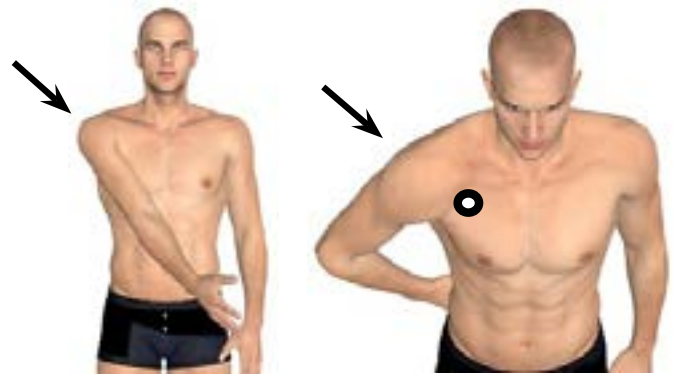
Trigger Points

Referred Pain



Signs of inhibition

The shoulder will appear rotated posterior and slightly elevated. As the muscle is frequently shortened, observe for rounding of the shoulders.



Strain counterstrain

The arm is internally rotated and the shoulder is then protracted and abducted until the trigger point pain is reduced. For excessively large patients, the forearm is placed behind the patient as this causes extension and internal rotation of the shoulder. Pressure is then applied to the scapula to move the shoulder forward and abducting it.

Common Recruitment - Testing Errors

Contacting inferior to the elbow allowing the patient to use the triceps. Be aware of any rotation of the arm or further abduction to recruit more of the pectoral muscles.

Comments

When the pectoralis minor is found to be shortened, the shoulder extensors especially the rhomboids, middle trapezius and latissimus should be tested. Correction of the problem requires strengthening of the involved shoulder extensor muscles. This is a major cause of thoracic outlet problems.



Common Recruitment

Latissimus dorsi

Origin

Arises from the crest of the ilium, the sacrum, the lumbar vertebrae and the lower six thoracic vertebrae. It also arises from the last three or four ribs.

Insertion

Along with the fibers of the teres major and the pectoralis into the intertubercular groove of the humerus.

Action

Depresses the shoulder and extends the humerus. Contraction of the latissimus will also adduct and aid in internal rotation of the humerus. The upper fibers of the muscle will retract the scapula. Bilateral contraction of the muscle causes extension of the thoracic spine.

Position of body part

The elbow is fully extended and the arm is internally rotated so that the palm is facing posterior. The arm is then abducted 20 degrees.

Stabilization

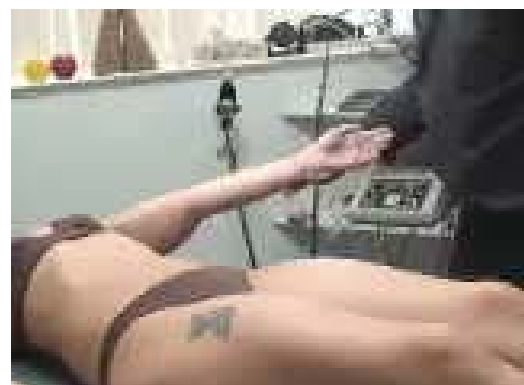
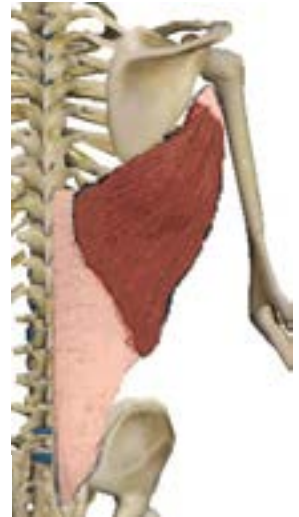
Contact is made over the shoulder being tested. This contact prevents the subject from elevating the shoulder or laterally bending the torso.

Contact

Contact over the lower arm just superior to the wrist. Care is used to avoid any bony contacts.

Vector of Force

Pressure is applied against the forearm as to abduct the arm at an angle of 20 degrees of flexion.



Nerve Supply C - 6, 7 & 8

Synergists

Humerus adduction: Teres major, long head of triceps

Scapula depression: Lower trapezius, abdominal external oblique

Antagonists

Humerus adduction: Supraspinatus, deltoids

Scapula depression: Upper trapezius, levator scapula

Signs of inhibition

In the standing posture, the shoulder will appear to be elevated and anterior on the side of weakness. Bilateral weakness will contribute to an increased kyphotic curve of the thoracic spine.

Strain counterstrain

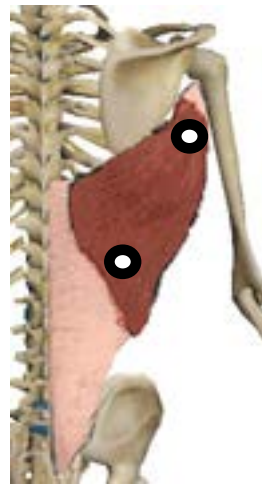
With patient sitting, palpate for the area of greatest tenderness. The arm is then extended 20 - 40 degrees, internally rotated and then adducted. Traction is then applied to the arm to pull the shoulder inferior. An alternative would be to press the shoulder inferior and slightly posterior.

Common Recruitment - Testing Errors

The first action will be to flex the elbow allow increased contraction of the biceps. Another action is to pull the arm in firmly against the torso. This causes increased contraction of the humeral adductors.

Comments

Inhibition of the muscle causes contraction of the opposing muscles (upper trapezius). This contributes to peripheral entrapment syndromes in the thoracic outlet. The trigger points in the upper trapezius will be relieved when pressure is applied to the shoulder as to augment the function of the latissimus. (apply pressure in a posterior and inferior direction)



Trigger Points

Referred Pain



Common Recruitment

Rhomboid

Origin

Minor: Spinouses of C - 7 & T - 1 and the ligamentum nuchae

Major: Spinouses of T - 2 - T - 5.

Insertion

Minor: Medial border of the scapula at the base of the spine of the scapula.

Major: Medial border of the scapula from the spine of the scapula to the inferior angle



Action

Draws and elevates the scapula towards the spine.

Gives stability to the scapula and shoulder.

Assists in adduction and extension of the arm by stabilizing the scapula in a retracted position.

Prevents winging of the scapula when carrying a weight in the arm.

Position of body part

Bend the elbow to 140 degrees and place the arm along the side of the thorax.

Instruct the patient to pull the scapula towards the spine and then elevate the scapula.



Stabilization

Contact the top of the shoulder and give firm support.

Contact

Grasp the forearm just distal to the elbow.

Vector of Force

Imagine a circle formed by the rotation of the scapula around the rib cage. Place your testing forearm at a tangent to this arc pulling lateral and anterior.



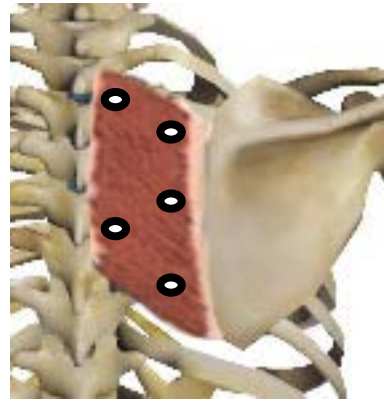
Nerve Supply C - 4 & 5

Synergists

Elevation: Levator scapula;
upper trapezius
Rotation: Levator scapula; latissimus
Arm abduction: Middle trapezius (stabilizes)
Retraction: Middle trapezius

Antagonists

Elevation: Latissimus; lower trapezius
Rotation: Upper trapezius
Arm abduction: Middle trapezius;
supraspinatus
Retraction: Pectoralis major and minor



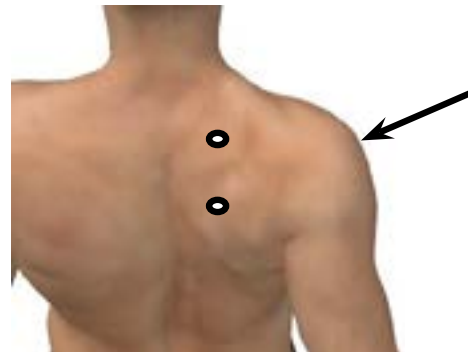
Trigger Points

Referred Pain



Signs of inhibition

Winging of the scapula.
Lateral deviation of the scapula.



Strain counterstrain

With the patient either prone or sitting, palpate and find the trigger point. Depress the shoulder and apply pressure as to push the scapula towards the spine moving scapula internally and slightly superior.

Common Recruitment - Testing Errors

The patient may depress the shoulder allowing the latissimus and inferior trapezius muscles to contract.

Comments

Inhibition of the rhomboid allows excessive rotation of the scapula when you reach forward with the arm. This can cause stretching of the suprascapular nerve and resultant inhibition of the infraspinatus muscle.



Common Recruitment

Levator Scapula

Origin

Arises from the transverse processes of the atlas and axis and the posterior tubercles of the transverse processes of the third and fourth cervical vertebrae

Insertion

Inserts into the superior aspect of the vertebral border of the scapula



Action

Contraction of the muscle elevates the scapula. It also rotates the scapula on the rib cage. It acts in pulling the glenoid fossa inferiorly. Unilateral contraction causes rotation of the neck. In combination with the opposite levator scapula, they limit the degree of cervical flexion.

Position of body part

Pressure is applied to depress the lateral aspect of the scapula while the patient elevates the medial aspect of the scapula.



Stabilization

Contact is made with the palm of the hand placed so that it is covering the medial border of the scapula with the finger tips over the lateral shoulder.



Contact

Contact is made by grasping the elbow which should be in close proximity to the iliac crest.

Vector of Force

Imagine a circle formed by the rotation of the scapula on the rib cage. Position your forearm at a tangent to this circle. Pressure is applied as to abduct and flex the arm.



Nerve Supply C - 3, 4 & 5

Synergists

Neck rotation: Opposite sternocleidomastoid,
ipsilateral splenius capitis,
splenius cervicis

Scapular elevation: Upper trapezius; upper fibers
of the serratus anterior

Antagonists

Cervical motion: Anterior scalene and ipsilateral
sternocleidomastoid

Scapular motion: Lower fibers of the serratus
anterior and the latissimus dorsi

Signs of inhibition

Inferior dropping of the superior angle of the scapula.
The inferior angle of the scapula moves towards the
mid-axillary line. On lowering the abducted arm, there
is a sudden shifting of the scapula when the rhomboid
contracts to stabilize the scapula.

Strain counterstrain

Stand behind the patient and palpate the trigger point.
Turn the head 40 degrees towards the side
being treated. Then bring the neck into extension
and lateral bending at a 45 degree angle until the
tenderness dramatically decreases.

Common Recruitment - Testing Errors

Common recruitment is an attempt to utilize the
rhomboid by elevation of the shoulder. Another is ac-
tivation of the long head of the triceps, infraspinatus
and the teres muscles by external rotation of the arm.

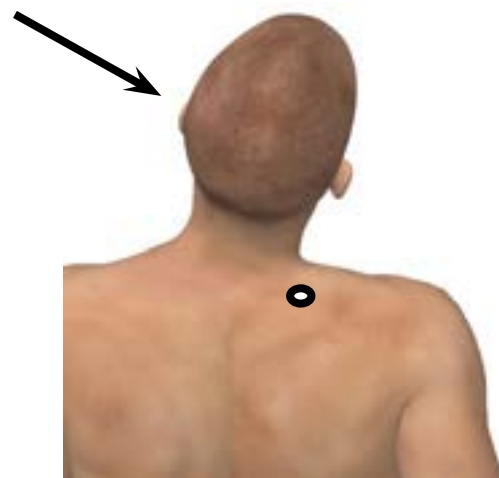
Comments

The levator scapula is one of the frequent locations
of trigger points in subject's with stiff neck. This is
almost a universal finding. Further examination will
usually uncover weakness in the latissimus, deltoids,
serratus anterior or the rhomboids.



Trigger Points

Referred Pain



Common Recruitment

Middle & Lower Trapezius

Origin

Middle: arise from the spinous processes from the sixth cervical to the third thoracic.

Lower: Arises from the spinous processes from the fourth thoracic to the twelfth thoracic.

Insertion

Middle: Inserts into the acromion process and into the spine of the scapula,

Lower: Inserts into the medial aspect of the spine of the scapula.



Action

Middle: Retracts the scapula and aids in elevation of the scapula. Assists in flexion and abduction of the humerus by rotating the scapula.

Lower: Retracts the scapula. Inferior stabilization of the scapula. Aids in spinal extension.

Position of body part

The elbow is extended and the arm externally rotated.

Middle: The arm is abducted 90 degrees and the scapula is retracted fully.

Lower: The arm is abducted 130 degrees and the scapula is retracted.



Stabilization

The hand is placed over the scapula.



Contact

Contact is made over the lower forearm.



Vector of Force

Middle: Pressure is applied anteriorly into arm flexion.

Lower: Pressure is applied in an anterior direction forcing the arm into flexion and adduction.

Nerve Supply

C - 2, 3 & 4 and the spinal accessory nerve.

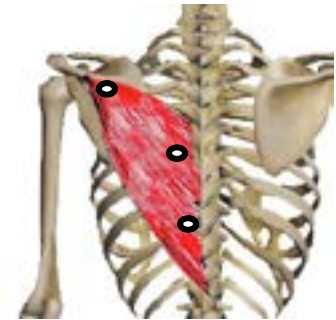
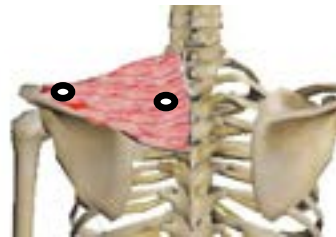
Synergists

Shoulder adduction: Rhomboids

Shoulder flexion: Deltoid, supraspinatus,
long head of the biceps

Antagonists

Shoulder adduction: Pectoralis muscles



Trigger Points

Referred Pain

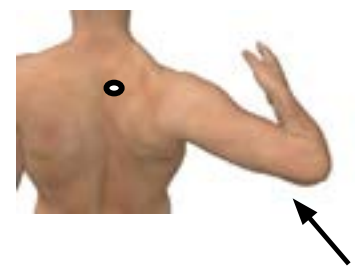
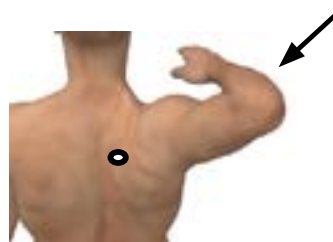
Signs of inhibition

Standing, the person will have a forward rotation of the scapula causing a round shoulder appearance



Strain counterstrain

Localize the trigger point. Flex the elbow and bring the arm posterior lining the humerus with the trigger point. For the lower trapezius the arm will be raised above the level of the shoulder.



Common Recruitment - Testing Errors

Shoulder or elbow injuries, pain, can cause inhibition.



Comments

These muscles when inhibited allow the scapula to protrude and contributes to the shortening of the pectoralis minor and entrapment of the brachial plexus.

Common Recruitment



Biceps

Origin

Short head: Tip of the coracoid process of the scapula.
Long Head: Supraglenoid tubercle of the scapula.

Insertion

Inserts into the radial tuberosity.



Action

Assists in flexion and abduction of the arm.
Flexes the elbow.
Aids in forearm supination.
The long head aids in holding the humeral head in the glenoid cavity.



Long Head

Position of body part

Bend the elbow to 80 degrees and place the forearm in supination.

Short Head



Stabilization

Contact the elbow and give firm support. For the long head, stabilize the shoulder

Contact

Grasp the forearm just above the wrist. For the long head, contact just proximal to the elbow.

Vector of Force

Imagine a circle formed by the rotation forearm. Place your testing forearm at a tangent to this arc. For the long head, press the humerus inferior



Nerve Supply C - 5 & 6

Synergists

Arm flexion: Anterior deltoid, supraspinatus
Elbow flexion: Brachialis, brachioradialis
Elbow supination: Supinator

Antagonists

Arm flexion: Posterior deltoid, latissimus, triceps
Elbow flexion: Triceps
Elbow supination: Pronators

Signs of inhibition

The patient must pronate the forearm before flexing the elbow.

Strain counterstrain

Palpate for the area of tenderness. For the short head, fully flex the elbow. For the long head, flex the humerus and then flex the elbow.

Common Recruitment - Testing Errors

Flexion of the fingers or hand facilitates the muscle.
Pronation of the forearm allows recruitment of the brachioradialis and the brachialis.
For the long head, internal rotation of the humerus allows the anterior deltoid to recruit and external rotation the coracobrachialis.

Comments

The biceps may be found to be over contracted causing reflex inhibition in either the forearm or the shoulder muscles.

Trigger Points

Referred Pain



Short Head



Long Head



Common Recruitment

Coracobrachialis

Origin

Arises from the tip of the coracoid process of the scapula.

Insertion

Into the medial border of the humerus opposite the deltoid tubercle.



Action

Contraction causes flexion and adduction of the arm. It aids in stabilizing the head of the humerus in the glenoid cavity.

Position of body part

The person is asked to place the arm so as to comb the back of their head. In this position, the humerus is in the position to test the muscle.



Stabilization

The shoulder is supported with a broad contact making sure that no pressure is applied to the epicondyles.



Contact

A broad contact is made against the humerus just proximal to the elbow.

Vector of Force

Pressure is applied at a tangent of the arc created by moving the humerus. The force will carry the humerus in a posterior and inferior direction.



Nerve Supply

Musculocutaneous nerve (C - 6 & 7)

Synergists

Flexion: Ant. deltoid, short head of the biceps
Adduction: Pectoralis, subscapularis, teres major & minor, infraspinatus, & the long head of the triceps

Antagonists

Flexion: Latissimus, infraspinatus
Adduction: Deltoids, supraspinatus, upper trapezius

Signs of inhibition

The subject will complain of difficulty combing the back of the head.

Strain counterstrain

Find the area of tenderness and then flex the elbow fully. Bring the arm into flexion and slight adduction until the tenderness reduces dramatically.

Common Recruitment - Testing Errors

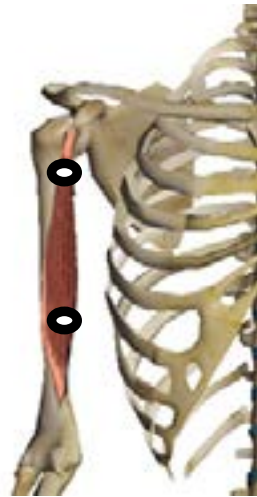
The patient will attempt to contract the pectoralis muscles as well as the anterior deltoid.

Comments

The coracobrachialis is used to brush or comb the hair on the back of the head. This is the easiest way to think of this muscle. If you ask the patient to touch the back of the head, you will be in the correct position to test the muscle.

Trigger Points

Referred Pain



Common Recruitment



Brachialis

Origin

Arises from the anterior surface of the humerus.

Insertion

Into the distal anterior surface of the olecranon.

Action

This is the major flexor of the elbow
Flexes the forearm.

Position of body part

The elbow is flexed 90 degrees with the palm in full pronation. This position limits the recruitment of the biceps.

Stabilization

Support is applied to the upper humerus.

Contact

The distal position of the forearm is contacted.

Vector of Force

Pressure is applied as to extend the forearm



Nerve Supply

Musculocutaneous nerve (C - 5 & 6)

Synergists

Elbow flexion: Biceps, brachioradialis

Antagonists

Elbow flexion: Triceps

Signs of inhibition

The arm hangs in extension and lifting items with a bent elbow is difficult.

Strain counterstrain

Palpate for the area of tenderness by pushing the biceps to the side and palpating under the bicep. Then, flex the forearm to approximate the ends of the muscle.

Common Recruitment - Testing Errors

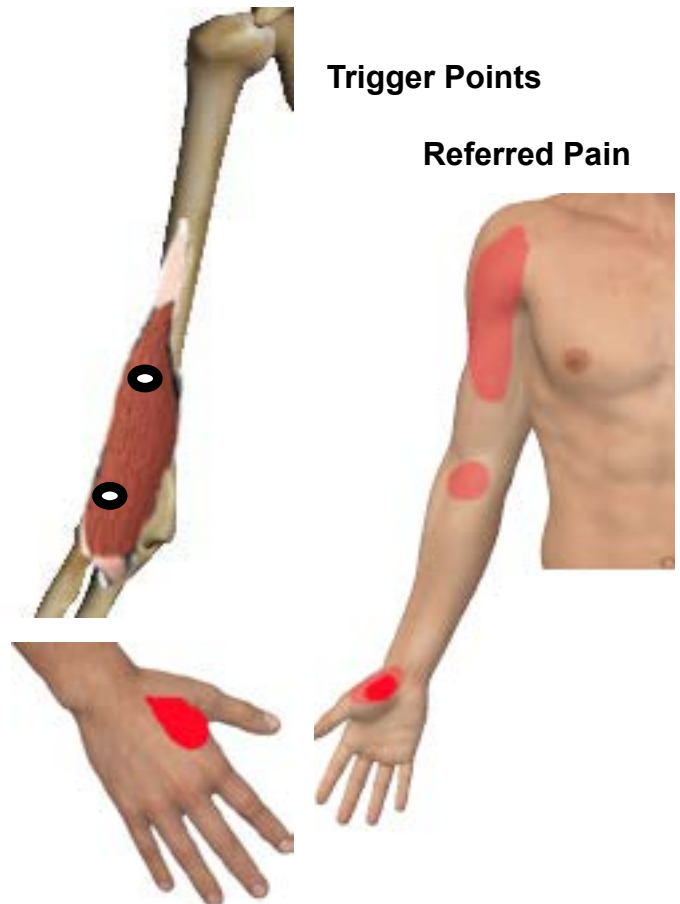
Allowing the patient to supinate the forearm recruiting the biceps. Flexion of the fingers or of the hand facilitates the muscle.

Comments

This muscle is commonly missed as it lies under the biceps but it is the major elbow flexor.

Trigger Points

Referred Pain



Common Recruitment

Brachioradialis

Origin

Upper two-thirds of the supracondylar ridge of the humerus and the lateral intermuscular septum.

Insertion

Inserts into the lateral side of the radius styloid process.

Action

Flexes the elbow.

This muscle becomes involved when the extensor carpi radialis becomes involved.

Position of body part

Bend the elbow to 80 degrees and place the forearm in a neutral position between pronation and supination.

Stabilization

Contact the elbow and give firm support.

Contact

Grasp the forearm just above the wrist.

Vector of Force

Imagine a circle formed by the rotation forearm. Place your testing forearm at a tangent to this arc.



Nerve Supply Radial nerve (C - 5 & 6)

Synergists

Elbow flexion: Biceps, brachialis

Antagonists

Elbow flexion: Triceps

Signs of inhibition

The arm hangs with the elbow in full extension. It refers pain to the lateral epicondyle.

Strain counterstrain

Palpate for the area of tenderness. Then, flex the forearm to approximate the ends of the muscle.

Common Recruitment - Testing Errors

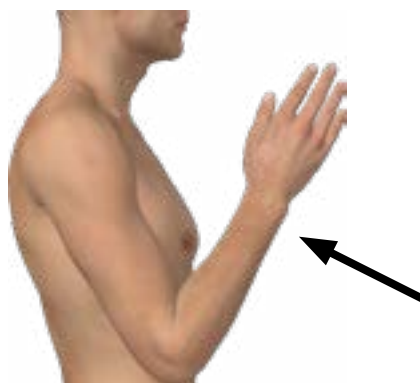
Failure to fully stabilize the arm during the test. Allowing the patient to supinate the forearm recruiting the biceps.

Comments

The brachioradialis is involved with quick motions of the forearm and hand. For example in throwing something with the arm or in turning the steering wheel.

Trigger Points

Referred Pain



Common Recruitment

Triceps

Origin

Long head: Scapular infraglenoid tubercle

Lateral head: Lateral & posterior proximal humerus

Medial head: Medial & posterior 2/3 of distal humerus

Insertion

The posterior surface of the ulna olecranon.

Action

Extends the elbow - all three heads.

Extends the arm with the long head.

Position of body part

With the humerus against the body, flex the elbow 80 degrees and rotate the forearm into pronation and supination to isolate the medial and lateral heads. For the long head, place the forearm in a neutral position at 90 degrees of flexion and extend the arm 10 - 15 degrees.

Stabilization

Contact the elbow or the shoulder and give firm support if needed.

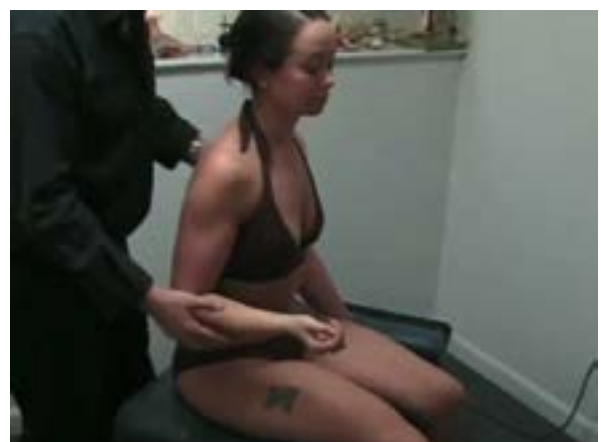
Contact

Grasp the forearm just above the wrist for the medial and lateral heads. The contact is on the back of the upper arm just proximal to the elbow for the long head

Vector of Force

Imagine a circle formed by the rotation forearm.

Place your testing forearm at a tangent to this arc.



Nerve Supply Radial nerve (C - 6 - T - 1)

Synergists

Elbow extension: The heads are synergistic
Arm extension: Latissimus, posterior deltoid

Antagonists

Elbow extension: Brachialis, biceps,
brachioradialis
Arm extension: Anterior deltoid, biceps

Signs of inhibition

The arm hangs with the elbow in increased flexion.

Strain counterstrain

Palpate for the area of tenderness. Then fully extend the forearm, bring the arm into extension and rotate slightly to find the area of greatest reduction in tenderness.

Common Recruitment - Testing Errors

Failure to fully stabilize the arm during the test.
Allowing the rotation of the forearm to allow recruitment of another head.
Extension of the hand or of the fingers.

Comments

Radial nerve may become involved in shortening of the long head.



Trigger Points

Referred Pain



Common Recruitment

Flexor carpi radialis

Origin

From the distal one third of the lateral supracondylar ridge of the humerus and the intermuscular septa.

Insertion

Attaches to the radial aspect of the second metacarpal on the dorsal surface.

Action

Causes extension and abduction of the wrist. Aids in flexion of the forearm.

Position of body part

The forearm is rotated into 80% pronation. The patient is asked extend the wrist and then to radially deviate the hand.

Stabilization

The middle of the forearm is stabilized

Contact

Fingers of the testing hand are placed over the dorsal surface of the second and third metacarpals.

Vector of Force

The patient is asked to hold the hand in extension and radial deviation. A strong contact is made and pressure is applied in the direction of flexion and ulnar deviation.



Nerve Supply C - 6, 7 & 8. Radial Nerve.

Synergists

Extension: Extensor digitorum, Extensor carpi ulnaris
Radial deviation: Adductor pollicis, Flexor carpi radialis
Elbow flexion: Biceps, brachioradialis, brachialis

Antagonists

Extension: Flexor carpi radialis and ulnaris, flexor digitorum superficialis and profundus, palmaris longus
Radial deviation: Extensor and flexor carpi ulnaris
Elbow flexion: Triceps

Signs of inhibition

Chronic weakness is evidenced by ulnar deviation of the hand as well as decreased strength of wrist extension.

Strain counterstrain

Palpate for the area of tenderness. With the fingers in extension and the hand in full extension rotate the hand slightly to find the position with the greatest reduction in tenderness.

Common Recruitment - Testing Errors

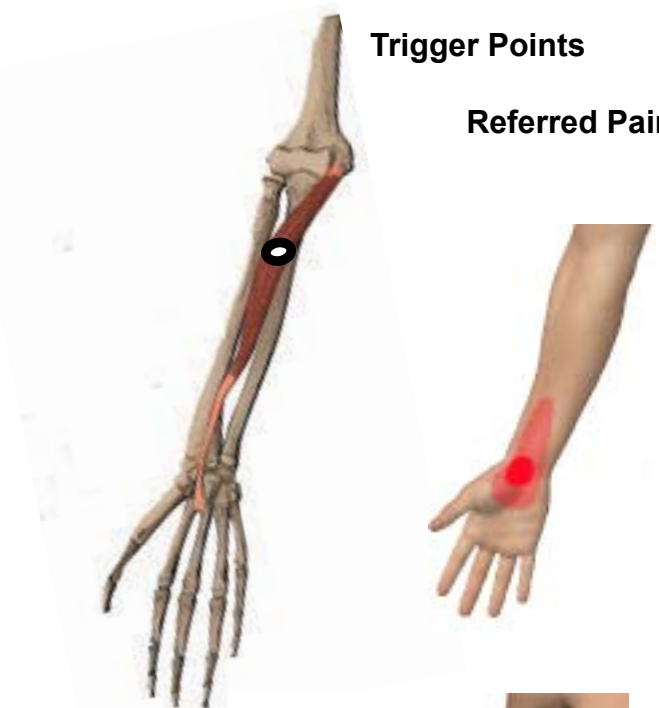
Applying pressure against a joint.
Extension of the fingers
Rotation of the hand allowing extensor carpi radialis to contract

Comments

This muscle would be the equivalent of the tibialis anterior of the lower leg

Trigger Points

Referred Pain



Common Recruitment

Flexor carpi ulnaris

Origin

Humerus head: Flexor tendon of the medial epicondyle.
Ulnar head: Olecranon and the proximal 2/3 of the posterior border of the ulna, and the intermuscular septa.

Insertion

Attaches to the pisiform.

Action

Causes flexion and adduction of the wrist.
Aids in flexion of the forearm.

Position of body part

The patient is asked flex the wrist and then to ulnar deviate the hand. The forearm is rotated into full supination.

Stabilization

The middle of the forearm is stabilized

Contact

Fingers of the testing hand are placed over the palmar surface of the hypothenar eminence.

Vector of Force

The patient is asked to hold the hand in flexion and ulnar deviation. A strong contact is made and pressure is applied in the direction of extension and radial deviation.



Nerve Supply C - 6, 7 & 8 . Median Nerve.

Synergists

Flexion: Flexor carpi radialis, Flexor digitorum superficialis and profundus

Ulnar deviation: Flexor digiti minimi,
Extensor carpi ulnaris

Elbow flexion: Biceps, brachioradialis, brachialis

Antagonists

Flexion: Extensor digitorum, Extensor carpi radialis and ulnaris

Ulnar deviation: Extensor and flexor carpi radialis

Elbow flexion: Triceps

Signs of inhibition

Chronic weakness is evidenced by radial deviation of the hand as well as decreased strength of wrist extension.

Strain counterstrain

Palpate for the area of tenderness. With the fingers in extension and the hand in full extension rotate the hand slightly to find the position with the greatest reduction in tenderness.

Common Recruitment - Testing Errors

Applying pressure against a joint.

Extension of the fingers

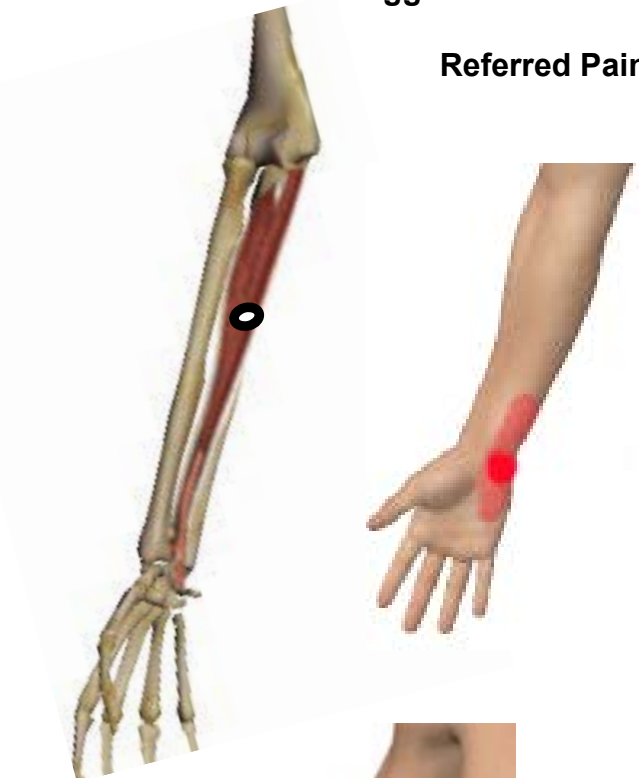
Rotation of the hand allowing extensor carpi radialis to contract

Comments

This muscle would be the equivalent of the peroneus longus of the lower leg

Trigger Points

Referred Pain



Common Recruitment

Extensor carpi radialis

Origin

From the distal one third of the lateral supracondylar ridge of the humerus and the intermuscular septa.

Insertion

Attaches to the radial aspect of the second metacarpal on the dorsal surface.

Action

Causes extension and abduction of the wrist.
Aids in flexion of the forearm.

Position of body part

Stabilization

The middle of the forearm is stabilized

Contact

Fingers of the testing hand are placed over the dorsal surface of the second and third metacarpals.

Vector of Force

The patient is asked to hold the hand in extension and radial deviation. A strong contact is made and pressure is applied in the direction of flexion and ulnar deviation.



Nerve Supply C - 6, 7 & 8. Radial Nerve.

Synergists

Extension: Extensor digitorum, Extensor carpi ulnaris
Radial deviation: Adductor pollicis, Flexor carpi radialis
Elbow flexion: Biceps, brachioradialis, brachialis

Antagonists

Extension: Flexor carpi radialis and ulnaris, flexor digitorum superficialis and profundus, and flexor carpi ulnaris
Elbow flexion: Triceps

Signs of inhibition

Chronic weakness is evidenced by ulnar deviation of the hand as well as decreased strength of wrist extension.

Strain counterstrain

Palpate for the area of tenderness. With the fingers in full extension and the hand in full extension, rotate the hand slightly to find the position with the greatest reduction in tenderness.

Common Recruitment - Testing Errors

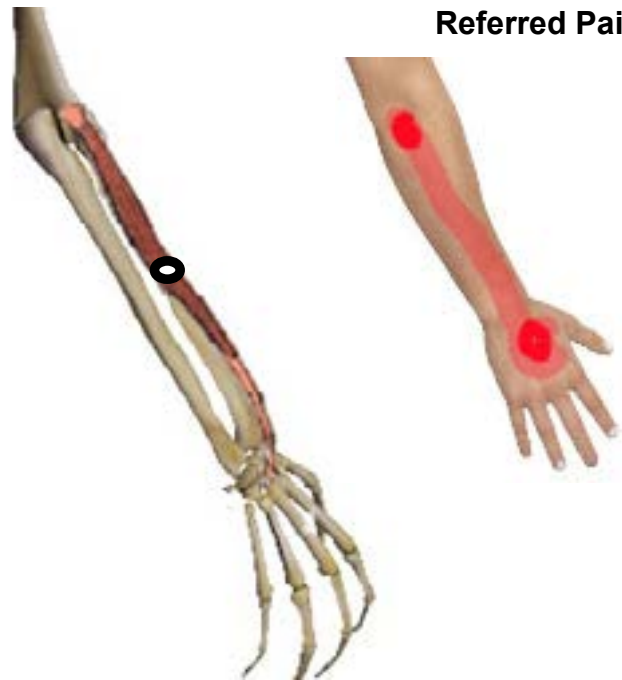
Applying pressure against a joint.
Extension of the fingers
Rotation of the hand allowing extensor carpi radialis to contract

Comments

This muscle would be the equivalent of the tibialis anterior of the lower leg

Trigger Points

Referred Pain



Common Recruitment

Extensor carpi ulnaris

Origin

From the extensor tendon of the lateral epicondyle of the humerus, and the posterior border of the ulna.

Insertion

Attaches to the base of the fifth metacarpal on the ulnar side.

Action

Causes extension and adduction of the wrist. Aids in flexion of the forearm.

Position of body part

The forearm is rotated into full pronation. The patient is asked to extend the wrist and then to ulnar deviate the hand.

Stabilization

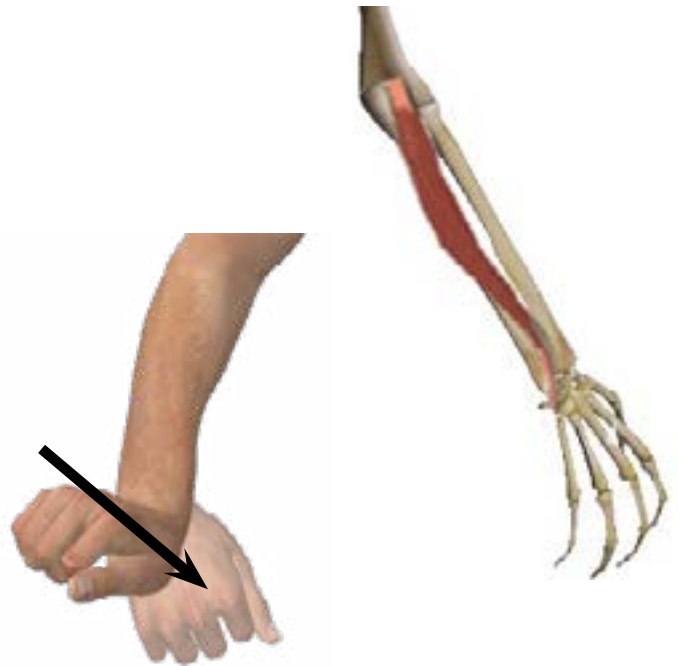
The middle of the forearm is stabilized

Contact

Fingers of the testing hand are placed over the dorsal surface of the fifth metacarpal.

Vector of Force

The patient is asked to hold the hand in extension and ulnar deviation. A strong contact is made and pressure is applied in the direction of flexion and radial deviation.



Nerve Supply C - 6, 7 & 8. Radial Nerve.

Synergists

Extension: Extensor digitorum,
Extensor carpi radialis
Ulnar deviation: Abductor digiti minimi,
Flexor carpi ulnaris
Elbow flexion: Biceps, brachioradialis, brachialis

Antagonists

Extension: Flexor carpi radialis, Flexor
digitorum superficialis and
profundus
Ulnar deviation: Extensor and flexor carpi radialis
Elbow flexion: Triceps

Signs of inhibition

Chronic weakness is evidenced by radial deviation of the hand as well as decreased strength of wrist extension.

Strain counterstrain

Palpate for the area of tenderness. With the fingers in full extension and the hand in full extension, rotate the hand slightly to find the position with the greatest reduction in tenderness.

Common Recruitment - Testing Errors

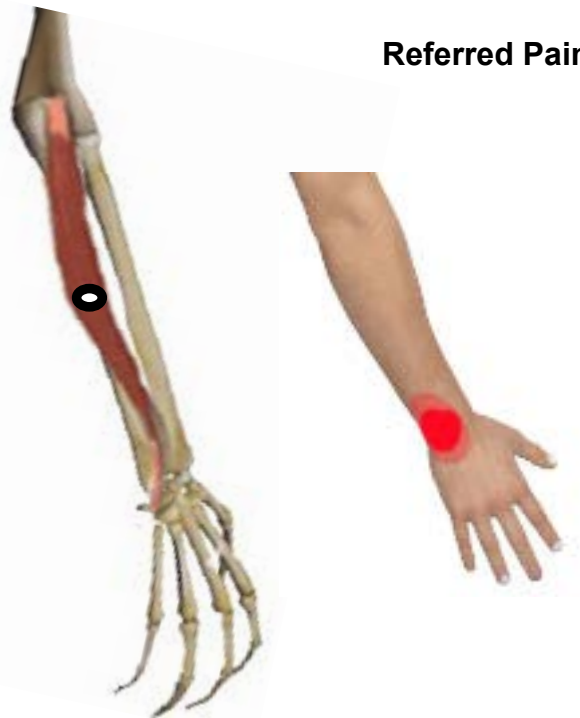
Applying pressure against a joint.
Extension of the fingers
Rotation of the hand allowing extensor carpi radialis to contract

Comments

This muscle would be the equivalent of the peroneus tertius of the lower leg

Trigger Points

Referred Pain



Common Recruitment

Pronator teres - quadratus

Origin

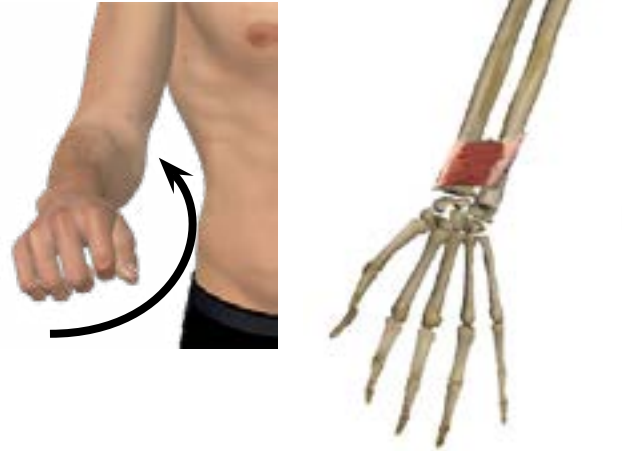
Teres: Superior to the medial epicondyle and the intermuscular septa. Medial aspect of the coronoid process of the ulna

Quadratus: Medial surface distal fourth of the ulna.

Insertion

Teres: Attaches to the lateral and middle surface of the radius.

Quadratus: Attaches to the lateral anterior surface of the distal fourth of the radius.



Action

Teres: Causes pronation of the forearm. Aids in flexion of the forearm.

Quadratus: Causes pronation of the forearm.

Position of body part

Teres: The forearm is flexed 45 degrees.
The forearm is fully pronated.

Quadratus: The forearm is flexed 135 degrees.
The forearm is fully pronated.



Stabilization

The lower portion of the humerus is stabilized..



Contact

The forearm just proximal to the wrist is firmly grasped.



Vector of Force

The patient is asked to hold the forearm in full pronation.
Pressure is applied to move the forearm into supination.

Nerve Supply C -6 & 7. Median Nerve.

Synergists

Pronation: Pronator teres and quadratus are synergistic

Pronator teres

Elbow flexion: Biceps, brachioradialis, brachialis

Antagonists

Pronation: Supinator

Pronator teres

Elbow flexion: Triceps

Signs of inhibition

Loss of strength in the hands

Strain counterstrain

Palpate for the area of tenderness and then rotate the forearm into full pronation.

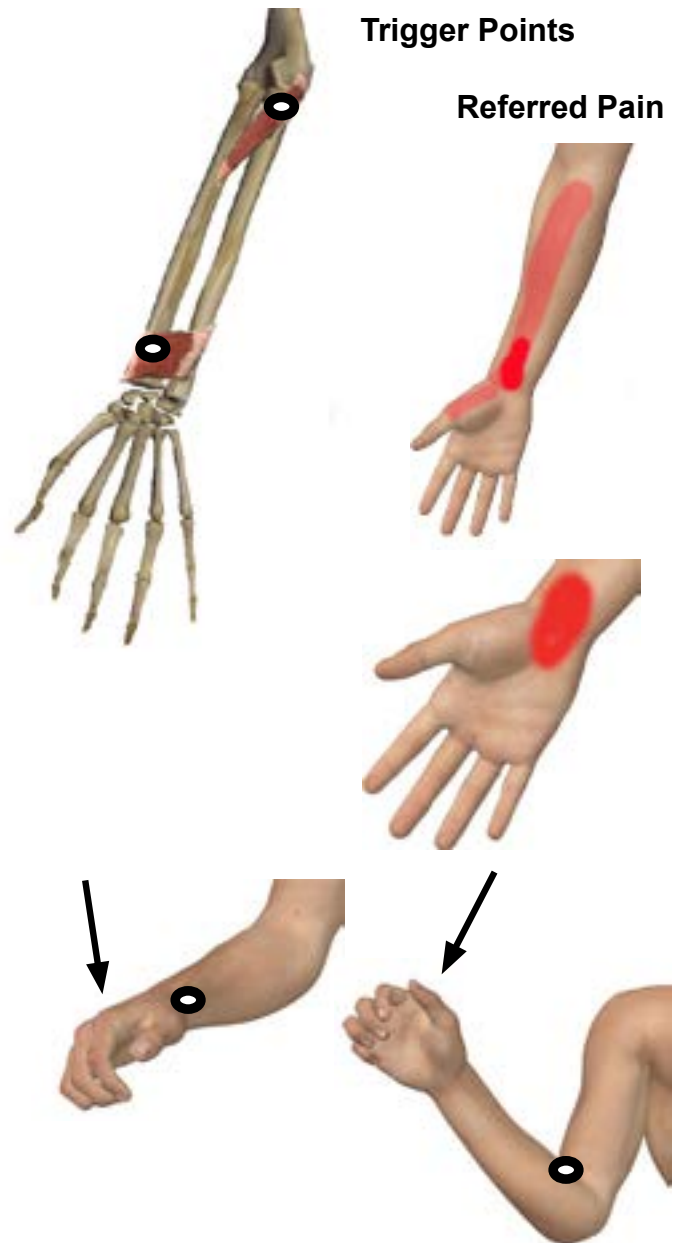
Common Recruitment - Testing Errors

Flexion of the hand

Applying stress against the joints of the hand

Comments

These muscles need to be tested when there is any possible nerve entrapment at the wrist or elbow.



Common Recruitment

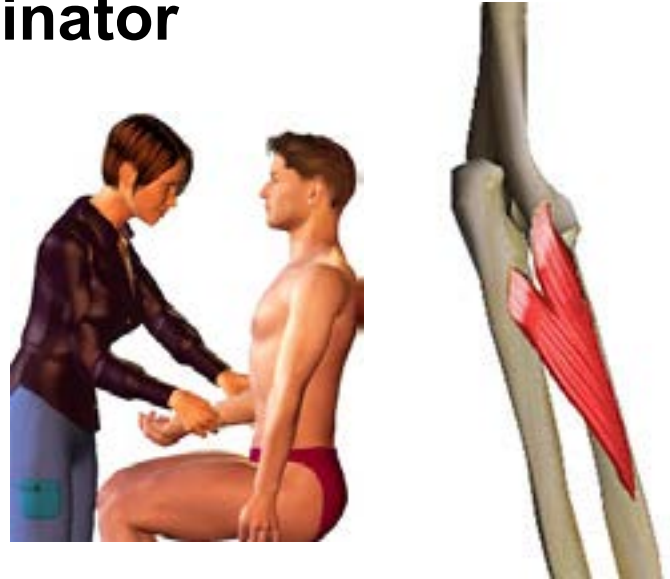
Supinator

Origin

From the lateral epicondyle of the humerus, radial and annular collateral ligament, and the supinator crest of the ulna.

Insertion

Attaches to the lateral anterior surface of the proximal one third of the radius.



Action

Causes supination of the forearm.

Position of body part

The forearm is flexed 90 degrees and then fully supinated



Stabilization

The lower portion of the humerus is stabilized.

Contact

The forearm just proximal to the wrist is firmly grasped.



Vector of Force

Pressure is applied to rotate the forearm into pronation.



Nerve Supply C -5 & 6. Radial Nerve.

Synergists

Supination: Biceps

Antagonists

Supination: Pronator quadratus & teres



Trigger Points

Referred Pain



Signs of inhibition

Chronic weakness is evidenced by the arm hanging in a state of pronation.

Strain counterstrain

Palpate for the area of tenderness and then rotate the forearm into full supination.



Common Recruitment - Testing Errors

Grasping the wrist or hand causing pain when performing the test.

Comments

Involvement is found in tennis elbow and medial epicondylitis
Contraction of the muscle can cause entrapment of the radial nerve



Common Recruitment

Flexor digitorum superficialis

Origin

Humerus head: Medial epicondyle of the humerus, ulnar collateral ligament, and the deep antebrachial fascia.

Ulnar head: Medial coronoid process of ulna

Radial head: Radial oblique line.

Insertion

The tendon splits at the first phalanx to go around the tendon of the flexor profundus and then inserts into the sides of the middle phalanx of the fingers.



Action

Causes flexion of the proximal interphalangeal joints of the fingers.

Aids in flexion of the wrist.

Position of body part

The patient is asked to flex the first interphalangeal joints of the hand.

Stabilization

The hand is stabilized by grasping it around the metacarpal bones.



Contact

Fingers of the testing hand are placed over the palmar surface of the distal portion of the proximal phalanges of the four fingers.

Vector of Force

The patient is asked to hold finger in flexion while pressure is applied as to extend the proximal phalanx.



Nerve Supply Second and third fingers: C - 7 & 8 T - 1 . Median Nerve.
Third and fourth fingers: C - 7 & 8 T - 1 . Ulnar Nerve.

Trigger Points

Synergists

Flexion: Flexor digitorum profundus

Referred Pain

Antagonists

Flexion: Extensor digitorum

Signs of inhibition

Chronic weakness is evidenced by an extremely weak grip.



Strain counterstrain

Common Recruitment - Testing Errors

Chronic weakness is evidenced by difficulty in picking up small objects.

Comments

This is an important muscle to test in suspected cases of entrapment of the median or ulnar nerve above the level of the carpal tunnel.



Common Recruitment

Flexor digitorum profundus

Origin

Proximal three-fourths of the ulna on its anterior and medial surfaces, the interosseous membrane and the deep antebrachial fascia.

Insertion

Attaches into the anterior surface of the distal phalanx of the fingers.

Action

Causes flexion of the distal interphalangeal joints of the fingers.
Aids in flexion of the fingers, hand and wrist.

Position of body part

The patient is asked flex the distal interphalangeal joints of the fingers.

Stabilization

The hand is stabilized by grasping it around the proximal phalanges, and taking care to avoid any bony contacts

Contact

Fingers of the testing hand are placed over the palmar surface of the entire surface of the distal phalanges of the four fingers. Usually the four divisions, for each finger, are tested separately.

Vector of Force

The patient is asked to hold finger in flexion while pressure is applied as to extend the distal phalanx



Nerve Supply Second and third fingers: C - 7 & 8 T - 1 . Median Nerve.
Third and fourth fingers: C - 7 & 8 T - 1 . Ulnar Nerve.

Trigger Points

Synergists

Flexion: Flexor digitorum superficialis

Antagonists

Flexion: Extensor digitorum

Signs of inhibition

Chronic weakness is evidenced by difficulty in picking up small objects.

Strain counterstrain

Move the finger into flexion to isolate the section of the muscle involved. Then palpate for tenderness. The finger or fingers are then totally flexed while palpating for reduction in the muscle.

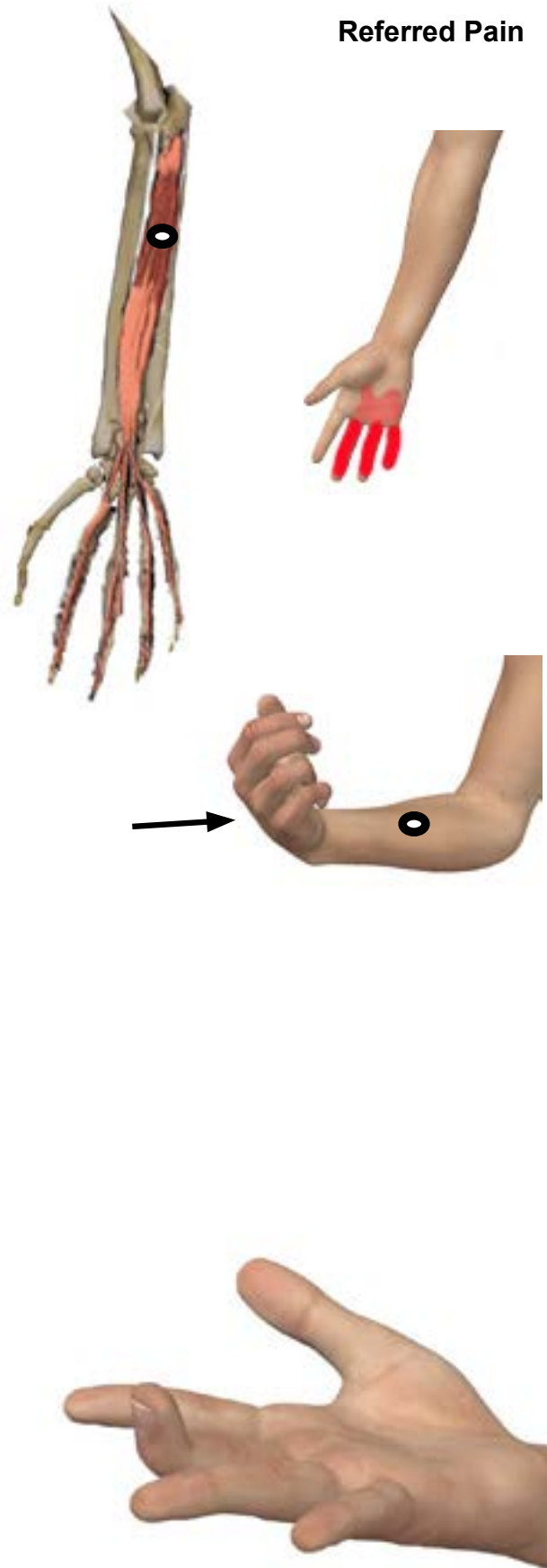
Common Recruitment - Testing Errors

Take care not to use excessive force on the joints of the fingers.

Comments

Test when nerve entrapment at the elbow is suspected

Referred Pain



Common Recruitment

Opponens pollicis

Origin

Arises from the flexor retinaculum and the tubercle of the trapezium.

Insertion

Attaches along the entire length of the radial aspect of the first metacarpal bone.

Action

Contraction causes abduction, flexion and rotation of the first metacarpal bone.

This motion opposes the thumb towards the little finger.

Position of body part

The thumb is held straight and the patient is asked to oppose the thumb and the little finger. When the correct position of the thumb is attained, the thumb nail can be seen when looking at the palm of the hand. This ensures that rotation of the metacarpal has occurred.

Stabilization

The hand is stabilized by grasping it and taking care to avoid any bony contacts.

Contact

Fingers of the testing hand are placed along the medial aspect of the thumb.

Vector of Force

The patient is asked to hold the thumb towards the little finger along the palm. Pressure is then applied to extend, adduct and laterally rotate the thumb pulling it away from the palm.



Nerve Supply C - 6 & 7. Median Nerve.

Synergists

Adduction: Adductor pollicis brevis

Antagonists

Adduction: Abductor pollicis longus & brevis,
extensor pollicis longus & brevis

Signs of inhibition

Chronic weakness is evidenced by marked atrophy of the muscle. Symptoms reported will include a weak grip, difficulty in writing and loss of strength in doing fine work with the thumb and fingers like buttoning clothes.

Strain counterstrain

Palpate the muscle for localized tenderness. Then, bring the thumb towards the center of the hand while palpating for the reduction in tenderness

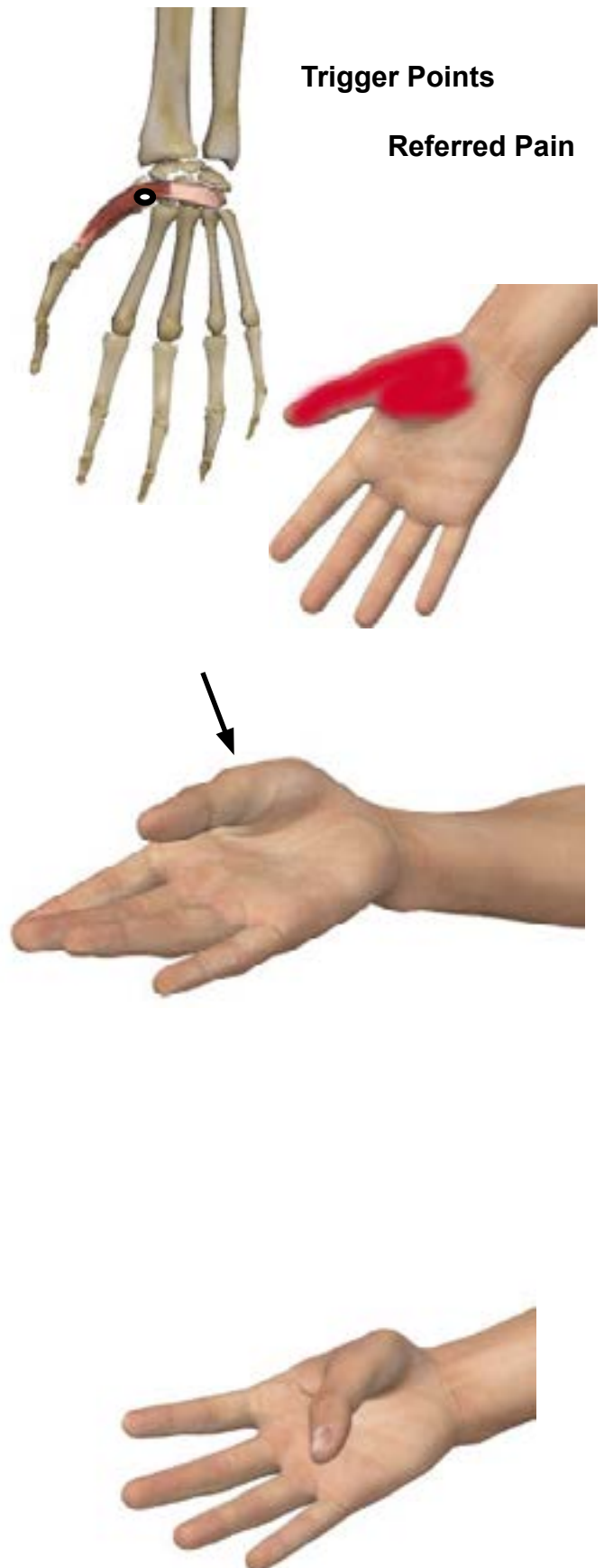
Common Recruitment - Testing Errors

Contacting over the joint.

Allowing the patient to flex the joints of the thumb

Comments

This will be found with entrapment of the median nerve. This can occur at the wrist, elbow or under the pectoralis minor muscle.



Common Recruitment

Opponens digiti minimi

Origin

Arises from the hook of the hamate bone and the flexor retinaculum

Insertion

Attaches into the length of the fifth metacarpal bone on the ulnar side.

Action

Causes opposition of the metacarpophalangeal joint of the little finger.

Position of body part

The patient is asked to oppose thumb and the little finger. The thumb is then returned to a neutral relaxed position.

Stabilization

The hand is stabilized by grasping it and taking care to avoid any bony contacts.

Contact

Fingers of the testing hand are placed over the palmar aspect of the distal portion of the fifth metacarpal.

Vector of Force

The patient is asked to hold the little finger in opposition while pressure is applied to press the finger as to flatten the hand (abduction, extension and rotation)



Nerve Supply C - 8 & T - 1. Ulnar Nerve.

Synergists

Flexion: Flexor digitorum superficialis and profundus

Antagonists

Flexion: Extensor digitorum

Signs of inhibition

Chronic weakness is evidenced by weakness of the grip and failure to cup the hand.

Strain counterstrain

Palpate the muscle for localized tenderness. Then, bring the fourth finger towards the thumb while palpating for the reduction in tenderness

Common Recruitment - Testing Errors

Contacting over the joint.

Allowing the patient to flex the joints of the finger

Comments

This will be found with entrapment of the ulnar nerve. This can occur at the wrist, elbow or under the pectoralis minor muscle.



Common Recruitment

Flexor digiti minimi

Origin

Arises from the hook of the hamate bone and the flexor retinaculum

Insertion

Attaches into the base of the proximal phalanx of the little finger.

Action

Causes flexion of the metacarpophalangeal joint of the little finger.

Aids in opposition of the thumb and little finger.



Position of body part

The patient is asked to flex the little finger. The inter-phalangeal joints are kept in an extended position.

Stabilization

The hand is stabilized by grasping it and taking care to avoid any bony contacts.



Contact

Fingers of the testing hand are placed over the palmar aspect of the distal portion of the proximal phalanx.

Vector of Force

The patient is asked to hold the little finger in flexion while pressure is applied to press the finger as to extend the proximal phalanx on the fifth metacarpal.



Nerve Supply C - 6, 7 & 8 . Radial Nerve.

Synergists

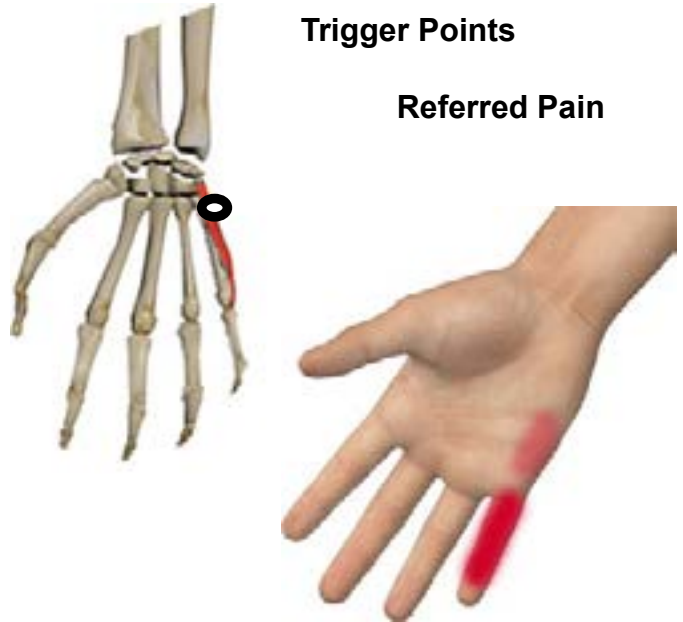
Flexion: Opponens digiti minimi, flexor digitorum superficialis and profundus

Antagonists

Flexion: Extensor digitorum

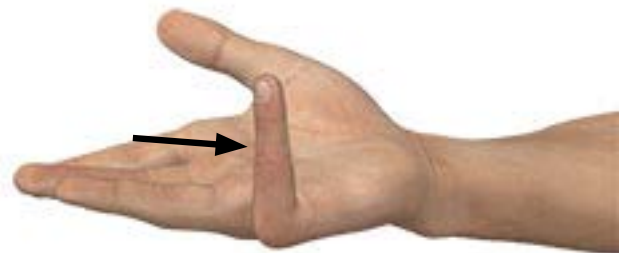
Trigger Points

Referred Pain



Signs of inhibition

Chronic weakness is evidenced by the hand hanging in a flexed position



Strain counterstrain

Palpate the muscle for localized tenderness. Then, flex the fourth finger palpating for the reduction in tenderness

Common Recruitment - Testing Errors

Excessive force or applying pressure over the joint.
Allowing the patient to flex any of the joints of the finger

Comments

This will be found with entrapment of the ulnar nerve.
This can occur at the wrist, elbow or under the pectoralis minor muscle.



Common Recruitment

Rectus Abdominus

Origin

From the symphysis pubis and from the crest of the pubis.

Insertion

Into the costal cartilages of the fifth, sixth and seventh ribs and into the lateral aspects of the xiphoid process.



Action

The muscle supports the abdominal viscera, aids in anterior support for the pelvis. It aids in the respiratory process through its reflex relaxation during inspiration and its contraction during forced expiration.



Position of body part

The patient is placed in a sitting position. The knees can be slightly bent. The spine is erect. Care is taken to prevent lumbar flexion. The person is instructed to cross their arms and contact the opposite shoulder.



Stabilization

Pressure is applied to the lower legs bilaterally.

Contact

Grasp the crossed arms and apply pressure to extend the spine. If the person has a shoulder problem, keep the hands off of the shoulders.

To test the lowest portion, the pyramidalis, the torso is flexed 15 degrees.

Vector of Force

Force is applied at a tangent to the arc created by the motion of the upper body. Keep your forearm at this perpendicular angle to the persons body.



Nerve Supply T 7, 8, 9, 10, 11, 12

Synergists

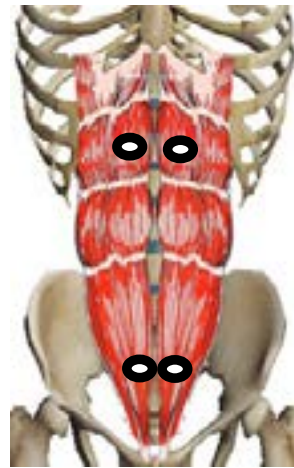
Lumbar flexion: Psoas, Abdominal obliques

Pelvic flexion: Gluteus maximus, Hamstrings,
Abdominal obliques

Antagonists

Pelvic flexion: Rectus femoris, sartorius

Lumbar flexion : Quadratus lumborum,
Erector spinae



Trigger Points

Referred Pain



Signs of inhibition

Weakness of the total muscle effects pelvic mechanics and leads to an anterior motion of the pelvis. Weakness of either the upper or lower segments will result in bulging of the abdominal wall. The bulging can either be in the upper or lower segments or the total abdominal area. This is easily viewed from the side.

Strain counterstrain

Find the greatest area of tenderness in the muscle. Standing behind, slowly flex the chest on the abdomen and then continue to flex the spine. Slightly rotate towards the opposite side to find the greatest reduction in tenderness. After, give resistance as the person sits back to a normal posture.

Common Recruitment - Testing Errors

Pressure is applied in a downward direction abnormally increasing the relative strength of the person. Expiration will increase the relative strength of the muscle. The person flexes the spine to recruit the psoas.

Comments

The rectus abdominus can be tested for weakness in its various sections by varying the degree of lumbar extension and rotating the trunk. The higher the segment to be tested, the more the person must be placed into lumbar extension.

Over contraction of the upper or lower section of the muscle can create a reflex weakness in the other segment. This coupled with the inherent breathing patterns of males and females leads to the bulging of the abdomen so often seen.



Common Recruitment

Abdominal Oblique

Origin

From the lower borders of the ninth to the twelfth ribs.



Insertion

Into the lateral surface of the iliac crest.



Action

The muscle supports the abdominal viscera, aids in rotational support for the pelvis. It aids in the respiratory process through its reflex relaxation during inspiration and its contraction during forced expiration.



Position of body part

The patient is placed in a sitting position. The knees can be slightly bent. The spine is erect. Care is taken to prevent lumbar flexion. The person is instructed to cross their arms and contact the opposite shoulder. The person is then rotated fully to the opposite side.



Stabilization

Pressure is applied to the lower legs bilaterally.

Contact

Grasp the crossed arms and apply pressure to extend the spine. If the person has a shoulder problem, keep the hands off of the shoulders.

Vector of Force

The pressure is applied directly through the shoulders. Keep your forearm at this perpendicular angle to the persons body.



Nerve Supply

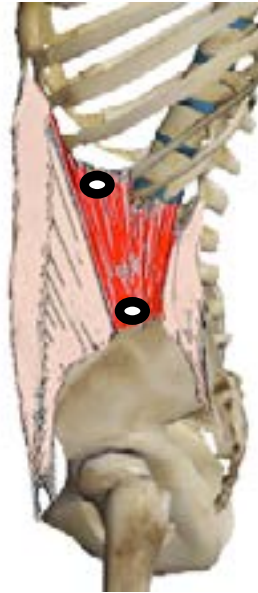
From T - 5 to T - 12.

Synergists

Lumbar flexion: Psoas, Rectus abdominus
Pelvic rotation: Opposite quadratus lumborum

Antagonists

Lumbar flexion: Quadratus lumborum
Pelvic rotation: Gluteus medius



Trigger Points

Referred Pain



Signs of inhibition

Weakness of the muscle affects pelvic mechanics and leads to a rotational motion of the pelvis. Weakness of the muscle will result in a lateral bulging of the abdominal wall. This is easily seen from the front.



Strain counterstrain

Find the greatest area of tenderness in the muscle. Standing behind, slowly flex and rotate the chest on the abdomen and then continue to flex the spine. Rotate towards the opposite side to find the greatest reduction in tenderness. After, give resistance as the person sits back to a normal posture.

Common Recruitment - Testing Errors

Pressure is applied in a downward direction abnormally increasing the relative strength of the person. Expiration will increase the relative strength of the muscle. The person flexes the spine to recruit the psoas.



Comments

Pain in the muscle is a common complaint of runners getting "stitches" in their side.

Weakness of the muscle may result in a rotational instability of the pelvis.

Weakness fails to support the underlying organs.

Trigger points can cause symptoms similar to heart burn or epigastric pain.



Common Recruitment

Quadratus Lumborum

Origin

The muscle arises from the posterior superior surface of the iliac crest and from the iliolumbar ligament.

Insertion

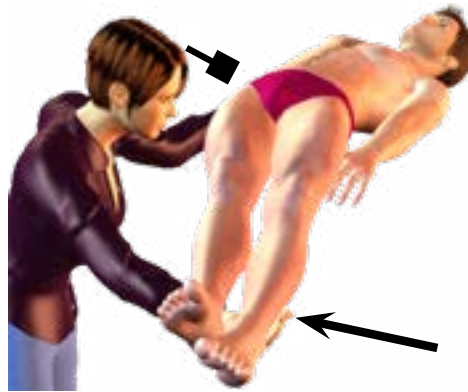
Inserts into the transverse processes of the first, second, third and fourth lumbar vertebrae and into the inferior surface of the twelfth rib.

Action

Elevates the pelvis if the rib cage is fixed or laterally bends the lumbar spine if the pelvis is fixed.

Position of body part

The patient is placed in a supine position. The pelvis is moved towards the side of the test to form a "C". The legs are kept together.



Stabilization

Pressure is applied against the pelvis.



Contact

Reach under the legs and grasp the outer leg above the malleolus.

Vector of Force

Pull the legs towards your body without allowing the patient to pull their heels into the table.



Nerve Supply From T - 12 to L - 3.

Synergists

Lumbar lateral bending: Ipsilateral Psoas,
Abdominal oblique

Antagonists

Lumbar lateral bending: Opposite Quadratus
lumborum, Abdominal
oblique



Trigger Points

Referred Pain

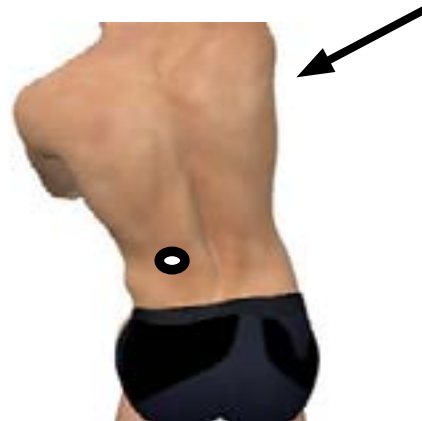


Signs of inhibition

Over development of the opposite quadratus lumborum. Elevation of the twelfth rib. Rotation and lateral curvature of the lumbar spine.

Strain counterstrain

Palpate and find the tender trigger point. The patient is then brought into extension, lateral bending and slight posterior rotation to find the position that reduces the tenderness over 70 percent.



Common Recruitment - Testing Errors

Patient will attempt to “dig” their heels into the table by extending the legs or roll their pelvis.

Comments

The quadratus lumborum is many times found contracted contributing to approximation of the facets in the lumbar spine. This condition is frequently found when the gluteus maximus is found weak.

A unilateral weakness is frequently found in cases of scoliosis.



Common Recruitment

Psoas

Origin

Firmly to the vertebral bodies, discs from T - 12 to L - 5 and to the transverse processes of L - 1 to L - 5.

Insertion

Inserts into the lesser trochanter of the femur on the posterior medial aspect.

Action

Flexion of the femur.

Standing: Flexes the lumbar spine.

When normal lordosis is present, it assists in lumbar flexion in the standing position.

Position of body part

With the knee extended, the leg is abducted 30 degrees and then the leg is flexed to 60 degrees. If the test is done sitting, the knee is bent at 90 degrees, flexed 30 degrees and abducted 30 degrees.

The leg can be abducted at different angles to isolate the lower or upper fibers of the psoas.

Stabilization

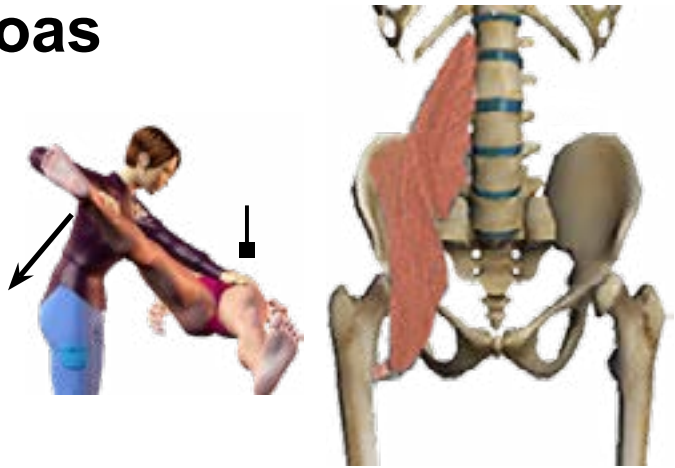
Pressure is applied over the opposite upper thigh to stabilize the pelvis preventing rolling. In the sitting position test, the stabilization is applied to the opposite shoulder

Contact

Grasp the lower leg above the medial malleolus. Avoid contacting the malleolus. In a sitting test, contact just above the knee on the medial aspect.

Vector of Force

Pressure is applied in the direction of a tangent to the arc created by the motion of the femur.



Nerve Supply L 1, 2, 3, 4
Femoral nerve

Synergists

Thigh flexion: Rectus femoris, pectineus, tensor fascia lata, gracilis, Adductor brevis, longus & anterior portion of magnus.

Lumbar flexion: Opposite psoas, rectus abdominus

Lumbar extension: Quad. lumborum, erector spinae.

Antagonists

Thigh flexion: Gluteus maximus, hamstrings, adductor magnus (posterior portion)

Lumbar flexion: Quadratus lumborum, erector spinae

Signs of inhibition

Short stride - The weakness will produce an exaggerated lower leg kick when walking or a lateral rotation of the pelvis as the oblique abdominals pull the pelvis anterior.

Ipsilateral weakness - lumbar scoliosis

Bilateral weakness - lumbar hypolordosis

Strain counterstrain

While holding the trigger point flex the thigh and bring it into adduction with the thigh starting over the umbilicus. Change the angle of the femur to find the position of greatest reduction in tenderness.

Common Recruitment - Testing Errors

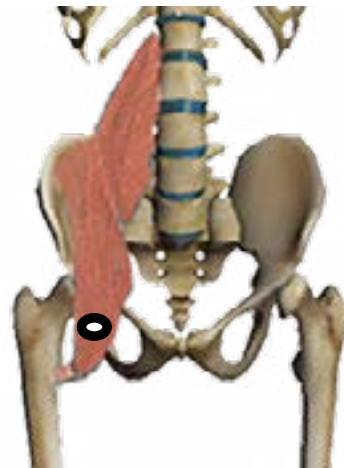
Failure to externally rotate the leg. The person is allowed to rotate pelvis.

Stabilization pressure is applied to the anterior superior iliac spine causing pain.

The person strongly dorsiflexes the foot causing facilitation of the leg flexors

Comments

Due to the attachment on the lumbar vertebrae, testing may have to be altered to isolate specific sections of the muscle. If inability is found in the lower lumbar spine, abduct the leg farther from the midline stressing lower fibers. If a scoliosis begins in the upper lumbar spine, abduct the leg only 10 -20 degrees isolating the upper fibers,



Trigger Points

Referred Pain



Psoas tested in the sitting position for a weight bearing test



Common Recruitment

Rectus Femoris

Origin

There are two tendons for attachment of the rectus femoris at the pelvis. One attaches to the anterior inferior iliac spine and the other attaches superior to the brim of the acetabulum.

Insertion

The muscle then descends and inserts into the upper border of the patella along with the fibers of the vastus muscles. The tendon of the quadriceps then inserts into the tibial tubercle.

Action

Flexes the thigh on the pelvis and extends the lower leg on the femur. It is the muscle that initiates the forward motion of the femur in walking after toe off. The muscle is more active than other sections of the quadriceps in climbing stairs.

Position of body part

The knee is flexed at 90 degrees. The muscle is easily tested in the sitting or supine position.

Stabilization

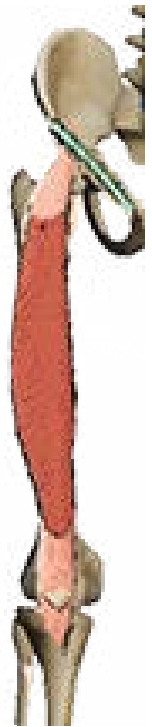
Pressure is applied against the lower femur at a tangent to the arc created by the motion of the knee.

Contact

A flat contact is made over the lower femur just proximal to the patella.

Vector of Force

Pressure is applied against the lower femur at a tangent to the arc created by the motion of the knee.



Nerve Supply L 2, 3 & 4: Femoral nerve

Synergists

Thigh flexion: Psoas, sartorius, adductors, TFL

Tibia Extension: Vastus muscle group

Antagonists

Thigh flexion: Hamstrings, gluteus maximus, adductor magnus

Tibia extension: Hamstrings, gluteus maximus, gastrocnemius

Signs of inhibition

This muscle is a primary anterior support of the pelvis. Weakness allows the innominate to rotate posterior and the pelvis will appear inferior on that side. Another sign of weakness is that the subject may have difficulty getting up from a sitting position. Walking with a short stride is another sign of weakness.

Strain counterstrain

Palpate for the tender area. With the knee fully extended, flex the femur on the body until the tenderness decreases at least 70%. After holding this position, give resistance as the person is instructed to push their leg back down to the table.

Common Recruitment - Testing Errors

The most common error is when pressure is applied over the patella creating pain. The next most common errors are when the direction of the force is not at a tangent to the arc of the motion of the leg. In the sitting test, errors occur when the subject is allowed to shift their weight to the other buttock rotating the femur.

Comments

The rectus femoris is the major anterior support of the pelvis. It may be found weak in posterior displacement of the tibia under the femur.



Trigger Points

Referred Pain



Vastus Intermedius, Medialis & Lateralis

Origin

- Lateralis:** Greater trochanter, lateral lip of the linea aspera; gluteal tuberosity
- Intermedius:** From the anterior and lateral 2/3 of the proximal femur
- Medialis:** Medial lip of the linea aspera and the intertrochanteric line

Insertion

Into the upper border of the patella along with the other fibers of the rectus femoris. The tendon of the quadriceps then inserts into the tibial tubercle. The medialis inserts into the medial border of the patella and the lateralis into the lateral border.

Action

Jointly, the muscles create extension of the knee. The medial and lateral sections support the knee on the medial and lateral aspects..

Position of body part

The knee is flexed at 70 degrees. The opposite knee is flexed at 45 degrees to allow for support for stabilization. The thigh is rotated to isolate the medialis and lateralis sections. With the femur internally rotated 15 degrees the lateralis is tested, if it is externally rotated 15 degrees the medialis is tested.

Stabilization

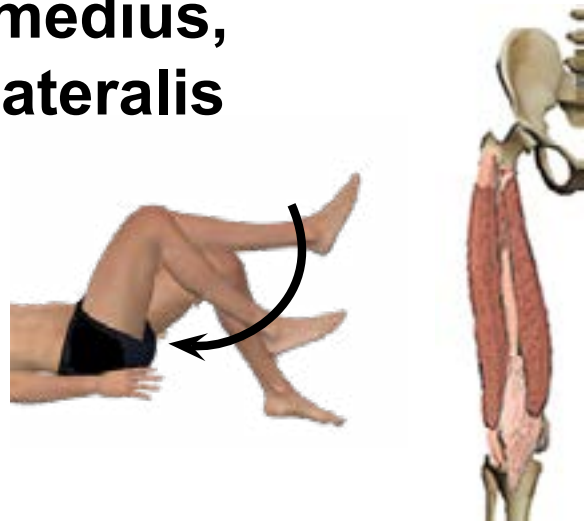
The stabilizing arm is placed behind the knee of the tested leg and the hand is placed over the opposite knee.

Contact

A flat contact is made over the lower leg just proximal to the ankle.

Vector of Force

Pressure is applied against the lower leg at a tangent to the arc created by the motion of the foot as the lower leg is extended.



Nerve Supply L - 2, 3 & 4. Femoral Nerve.

Synergists

Tibia extension: Vastus muscle group

Antagonists

Tibia extension: Hamstrings, gastrocnemius



Trigger Points

Referred Pain



Signs of inhibition

Abnormal position or motion of the patella in either the standing posture or during flexion and extension of the knee. If the examiner places his/her hands over the patella and instructs the subject to bend the knees, imbalances in the motion of the patella is easy to palpate.

Strain counterstrain

Palpate for the tender area. With the knee fully extended, flex the femur on the body until the tenderness decreases at least 70%. After holding this position, give resistance as the person is instructed to push their leg back down to the table.



Common Recruitment - Testing Errors

Pressure is applied over the tibia creating pain. The direction of the force is not at a tangent to the arc of the motion of the foot. In the sitting test, the subject is allowed to shift weight to the other buttock effectively rotating the femur allowing recruitment.

Comments

Inhibition is often associated with knee instability.

These muscles are very strong. Having the subject bend their knees five or six times to stress the muscles will help to uncover weaknesses. Care must be taken during the test that the subject does not contract the tibialis anterior as this may cause sufficient facilitation of the vastus muscles to hide a weakness.



Common Recruitment

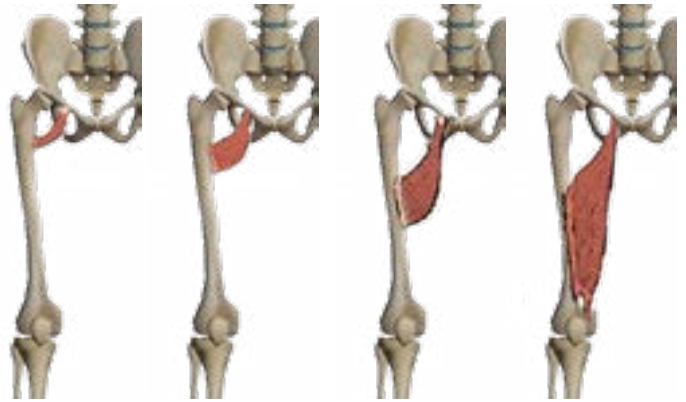
Adductors

Origin

- Pectineus: Superior surface of the pubis
- Add. Brevis: Inferior ramus of the pubis
- Add. Longus: Between the symphysis and the obturator
- Add. Magnus: Ischial tuberosity and Inferior pubic ramus

Insertion

- Pectineus: Lesser trochanter to the linea aspera
- Add. Brevis: Lesser trochanter to the linea aspera
- Add. Longus: Middle 1/3 of the femur on the linea aspera
- Add. Magnus: Adductor tubercle on the medial condyle of the femur



Action

Jointly, they adduct the thigh providing medial knee support. Medial rotation of the thigh is by the longus, brevis and anterior portion of the magnus when the body is loading the leg. They produce external rotation of the femur at the hip during terminal stance and pre-swing. Thigh extension is produced by the posterior portion of the adductor magnus



Position of body part

The classic test that stresses all of the adductors is done while the subject is side lying with the upper leg abducted and supported fully by the tester. The lower leg, the one being tested, is raised into abduction.



When supine, the individual sections can be isolated by changing the angle of abduction of the leg.

Stabilization

Support is provided with the testers body to stabilize the pelvis and prevent rolling of the pelvis. To some extent, stabilization is also provided by supporting the superior leg.

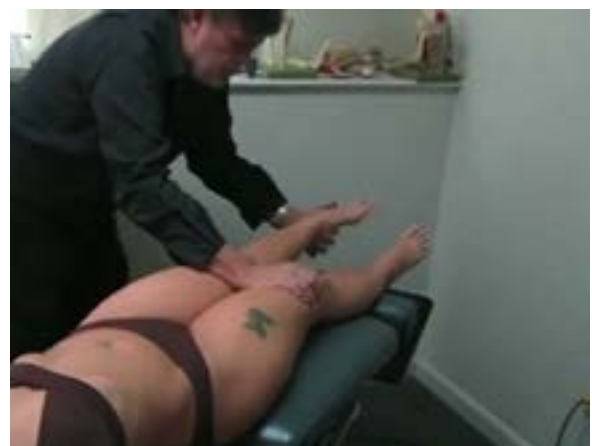


Contact

A flat contact is made on the medial aspect of the lower leg just proximal to the ankle.

Vector of Force

Pressure is applied against the leg at a tangent to the arc created by the motion of the leg as it is abducted. The force is towards the table and slightly inferior. The vector is parallel to the floor when the supine test is used.



Nerve Supply Adductor longus, brevis and magnus - Obturator nerve. L - 2, 3 & 4.
Posterior portion of the magnus - Sciatic nerve. L - 4, 5 & S - 1.

Synergists

Thigh adduction: Gracilis
Medial thigh rotation: Anterior portion of the gluteus medius, medial hamstrings, Tensor fascia lata

Antagonists

Thigh adduction: Gluteus medius, Tensor fascia lata
Medial thigh rotation: Gluteus maximus, piriformis, psoas

Signs of inhibition

If the adductors are bilaterally weak, the subject walks with a wide stance. With a unilateral weakness, the leg will drift out from the midline. In a static posture, there will be lateral deviation of the pelvis from the midline. The subject may stand with a genu varus (bowlegged) stance.

Strain counterstrain

Flex and adduct the thigh. For the magnus and longus, the femur will be pressed towards the umbilicus. Move the leg superior and inferior to find the position of the greatest reduction in tenderness. For the brevis and the pectineus, the femur is pressed towards the opposite anterior superior iliac spine or the acetabulum.

Common Recruitment - Testing Errors

The legs must fully be supported by the tester before initiating the test.

Inadequate stabilization is given to prevent rotation of the pelvis.

In the supine test the person will pull their leg into extension activating the hamstrings

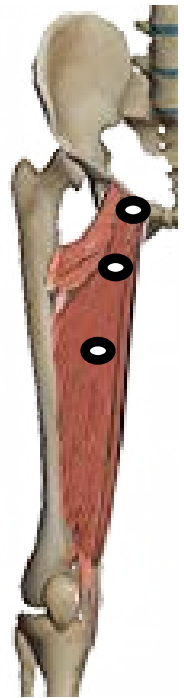
Comments

If the adductors are found weak as a group, first test for an obturator nerve syndrome. The short and long adductors should be considered as two separate muscle groups. They will often be found to have different problems. For example, if the lower adductors, the long adductors, are found to need strain counterstrain, then the upper, short adductors, may need to be treated with the fascial technique.

Groin pain can be caused by trigger points in the adductor longus, brevis or pectineus.

Trigger Points

Referred Pain



Adductor magnus

Adductor longus

Adductor brevis

Pectineus



Common Recruitment



Gracilis

Origin

Arises from the lower rim of the pubis at the junction of the pubis and the inferior pubic ramus

Insertion

Into the medial surface of the tibial body distal to the tibial condyle. It joins the tendons of the sartorius and the semitendinosus

Action

Functions in adduction of the thigh

Assists in thigh flexion..

Involved in flexion and internal rotation of the knee

Position of body part

The subject is tested in a prone position. The femur is extended 20 degrees, abducted 20 degrees and medially rotated. The knee is then flexed 20 - 30 degrees.

Stabilization

The leg is supported just superior to the knee.

Contact

A broad contact is made over the lower leg just above the medial malleolus over the postero-medial aspect of the leg.

Vector of Force

Pressure is applied to extend the knee with slight lateral pressure.

An alternative test for the gracilis is done in a supine position. The leg is rotated so that the foot rests over the opposite tibia. Contact is then made just proximal to the ankle and pressure is applied to move the leg into abduction. Stabilization is accomplished by reaching across the legs and contacting the opposite thigh. The testers forearm is parallel with the table during the test.



Nerve Supply L - 2, 3 &4 Obturator nerve

Synergists

Thigh adduction: Adductors, pectineus
Medial femur rotation: Adductors, anterior gluteus medius
Knee flexion: Hamstrings
Medial femur rotation: Adductors

Antagonists

Thigh adduction: Gluteus medius, Tensor fascia lata
Medial rotation: Gluteus maximus, posterior fibers gluteus medius, psoas

Signs of inhibition

Posterior rotation of the ipsilateral iliac crest
Tenderness over the lower or superior one third of the fibers of the muscle.
Lack of medial knee support while flexing the knee.

Strain counterstrain

Palpate for the area of pain. Then with the knee extended, bring the leg into flexion and adduction. Then rotate the femur to find the greatest reduction in tenderness.

Common Recruitment - Testing Errors

The subject attempts to recruit with the medial hamstring. The tester must maintain the position of the femur during the time of the test.

Comments

This muscle is rarely a problem by itself. It should be tested in chronic problems where coordination of function is important.

To help in finding imbalances in this muscle, have the subject activate the muscle by doing a "Twist" type dance and then test for proper function of the muscle.



Trigger Points

Referred Pain



Common Recruitment

Sartorius

Origin

Anterior superior iliac spine. It may also be attached to the inguinal ligament.

Insertion

To the medial surface of the body of the tibia anterior to the insertion of the gracilis and the semitendinosus. It may also be attached to the tendon of the patella.

Action

During the swing phase of gait it contributes to hip flexion. Aids in knee flexion. Aids the prime movers of thigh abduction, flexion and lateral rotation.

The muscle is extremely active in running, jumping, throwing, cycling, the tennis serve and in baseball batting.

Position of body part

The subject is placed as to do a Faber-Patrick test. The knee is flexed, the thigh is abducted and flexed and the heel is approximated to the opposite knee.



Stabilization

This test requires active motion of both hands. Stabilization is therefore provided by the patient using their hands to stabilize themselves on the table.

Contact

One hand is placed over the lateral aspect of the thigh just superior to the knee. Care is taken to avoid bony contacts. The other hand grasps the lower leg just above the malleoli.



Vector of Force

The hand on the lateral thigh applies pressure to extend, adduct and medially rotate the thigh. At the same time with equal pressure, the lower leg contact attempts to extend the knee.



Nerve Supply L - 2 & 3. Femoral nerve.

Synergists

Thigh flexion: Psoas, Tensor fascia lata & pectineus
Abduction: Gluteus medius, piriformis, TFL
Rotation: Gluteus maximus, post. fibers gluteus medius, long head of biceps femoris
Knee flexion: Short head of the biceps femoris

Antagonists

Thigh flexion: Gluteus maximus, hamstrings
Abduction: Adductors, gracilis
Lateral rotation: T.F.L., anterior fibers of gluteus medius, semimembranosus, semitendinosus, short adductors

Signs of inhibition

Posterior rotation of the ipsilateral iliac crest due to lack of anterior support.
Tenderness over the lower one third of the fibers of the muscle.
Lack of medial knee support while flexing the knee.
Standing, the subject may have a genu valgus (knock-knee) state.

Strain counterstrain

Palpate for the area of tenderness. Place the leg in the test position and apply pressure against the lateral side of the knee and rotate and flex the knee to find the position that reduces the tenderness.

Common Recruitment - Testing Errors

It is very important the two hands pull and push evenly.
If more force is applied on the lower leg, the patient will contract the hamstrings.
Avoid causing pain with the contact on the knee.

Comments

This muscle is one of the most difficult muscles to test properly. It requires coordinated motion of both arms. If you are small in stature, use your legs to deliver the force for the test. Practice rotating with your legs to rotate your pelvis to deliver the force required to test this muscle.

Medial knee support: Vastus medialis, gracilis, semitendinosus



Trigger Points

Referred Pain



Common Recruitment

Piriformis

Origin

Arises from the anterior surface of the sacrum from between the first and second sacral foramina to between the third and fourth sacral foramina, the sacroiliac joint capsule and the sacrospinous ligament

Insertion

Inserts into the medial, superior surface of the greater trochanter of the femur.



Action

Controls pelvic rotation on heel strike and during the initial stages of stance. It aids in stabilizing the femur head in the acetabulum. It functions as a lateral rotator of the femur when the femur is flexed less than 90 degrees. Above 90 degrees, the muscle changes to a medial rotator.



Position of body part

The muscle can be tested in the sitting, supine or prone positions. In all cases the femur should be flexed to just less than 90 degrees and the knee bent 90 degrees.



Stabilization

Pressure is applied at the knee to stabilize the femur.



Contact

Grasp the lower leg taking care not to apply pressure over the Achilles' tendon or over the malleoli.

Vector of Force

Pressure is applied against the lower leg to medially rotate the femur. The lower leg is used like a pipe wrench to torque the femur.



Nerve Supply L - 5 and S1 - 2

Synergists

Thigh lateral rotation: Gluteus maximus, long head of the Biceps femoris, posterior fibers of the gluteus medius, sartorius and psoas

Sacroiliac stability: Gluteus Maximus

Antagonists

Thigh lateral rotation: Semimembranosus, semitendinosus, Tensor fascia lata, pectineus, anterior fibers of the gluteus medius, adductor longus and adductor medius

Signs of inhibition

Medial rotation of the femur, this is especially evident when observing the patient walking. The patella will be rotated during the swing phase of gait. Depending on the function of other thigh rotators this same rotation will be present in the standing posture.

Strain counterstrain

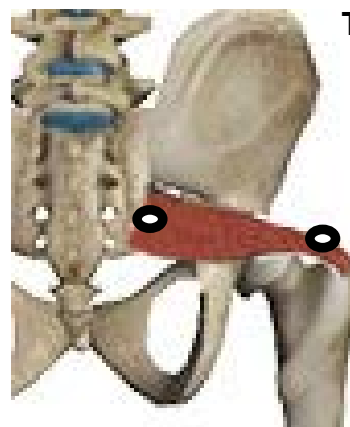
Palpate for the area of tenderness. Then bring the femur into extension and internally rotate the femur. The position is similar to a male dog urinating.

Common Recruitment - Testing Errors

Because the piriformis becomes a medial rotator with the femur flexed above 90 degrees, the subject will attempt to further flex the femur. The patient may also attempt to rotate the pelvis and move the foot to cause facilitation.

Comments

Over contraction of the piriformis is easily tested for by testing the range of motion of the femur in external and internal rotation. A decreased range of motion that is increased by approximating the sacroiliac joints (use a trochanter belt around the pelvis) indicates the presence of a hypertonic piriformis.



Trigger Points

Referred Pain



Common Recruitment

Tensor Fascia Lata

Origin

Arises from the anterior iliac crest and the anterior superior iliac spine.

Insertion

The anteromedial fibers insert into the lateral patellar retinaculum and into the deep fascia of the leg superficial to the patella ligament. The posterior fibers attach through the iliotibial tract into the lateral tubercle of the tibia

Action

In general, the muscle assists the prime movers of thigh flexion, abduction and medial rotation. The anterior fibers function in flexion and abduction and the posterior fibers in rotation. The posterior fibers also aid in locking the knee in extension.

Position of body part

The subject is tested in a supine position. The knee is extended and the femur is abducted 30 degrees, fully medially rotated and flexed 30 degrees.

Stabilization

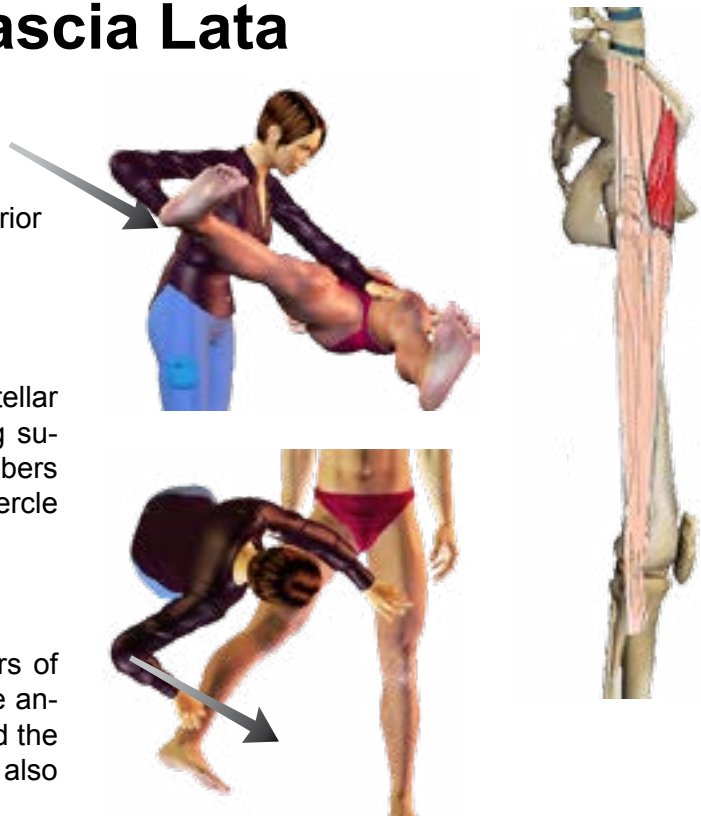
The opposite leg is supported. If the subject rotates the pelvis or slips on the table, have them grasp the table with their hands.

Contact

A broad contact is made over the lower leg just above the medial malleolus over the posterolateral aspect of the leg. Care is taken to avoid contacting the malleolus or to squeeze the lower leg.

Vector of Force

Pressure is applied in the direction of the opposite foot. The pressure is in the direction of thigh adduction and extension.



Nerve Supply L - 4, 5 and S - 1
Branch of the Superior gluteal nerve.

Synergists

Thigh flexion: Rectus femoris, psoas, pectineus, anterior, fibers of the gluteus medius, sartorius

Abduction: Gluteus medius

Knee extension: Popliteus, Rectus femoris, vastus

Antagonists

Thigh flexion: Gluteus maximus, hamstrings

Abduction: Adductors and gracilis

Trigger Points

Referred Pain



Signs of inhibition

The major sign of weakness of the muscle is a lack of lateral knee support while flexing the knee. If the weakness is chronic, the subject may have a genu varus (bow-legged) stance when standing. Weakness will also cause changes in the function of the iliotibial band.

Trigger points can cause trochanteric pain.



Strain counterstrain

Side lying, find the area of tenderness and abduct the leg until the tenderness is decreased at least 70%. Take care that the patient does not attempt to lift the leg while returning it to the table.

Common Recruitment - Testing Errors

The subject attempts to externally rotate the thigh or to flex the thigh. Care must be taken to fully support the leg prior to initiation of the test to help prevent any fatigue on the part of the subject..

Comments

The anterior fibers basically function in thigh flexion. To uncover imbalances in this section of the muscle, have the patient actively flex their thigh a number of times and then test for proper function of the muscle.

The posterior fibers of the tensor fascia lata function to stabilize the knee in extension. To isolate problems, you may have to have the patient actively hyperextend the knee and apply addition stress to the leg before testing the muscle.



Common Recruitment

Hamstrings

Origin

Semitendinosus: Ischial tuberosity.
 Semimembranosus: Lateral ischial tuberosity.
 Biceps femoris long head Ischial tuberosity and the sacrotuberous ligament. Short head the linea aspera, lateral supracondyle of the femur and intermuscular septum.

Insertion

Semitendinosus: Medial surface of the tibia.
 Semimembranosus: Into the tibial medial condyle.
 Biceps femoris: Lateral fibula head and the lateral aspect of the tibia.

Action

When the leg is free to move, the hamstrings flex the knee and extend the thigh on the pelvis. With the leg fixed, the hamstrings assist in maintaining erect posture while walking, and aid in the deceleration of the leg at the end of the swing phase of gait. The medial hamstrings aid in medial rotation and the lateral in lateral rotation of the thigh.



Position of body part

With the subject prone, the knee is flexed at 80 degrees. To isolate the medial and lateral heads, the thigh is rotated so that the lower leg rotates 30 degrees medial or lateral. To test the medial group the lower leg is rotated laterally; to test the lateral group the rotation is medial.

Stabilization

Pressure is applied in the belly of the hamstring, or if the patient attempts to elevate the pelvis to recruit the gluteal muscles, the pressure is applied over the iliac crest.

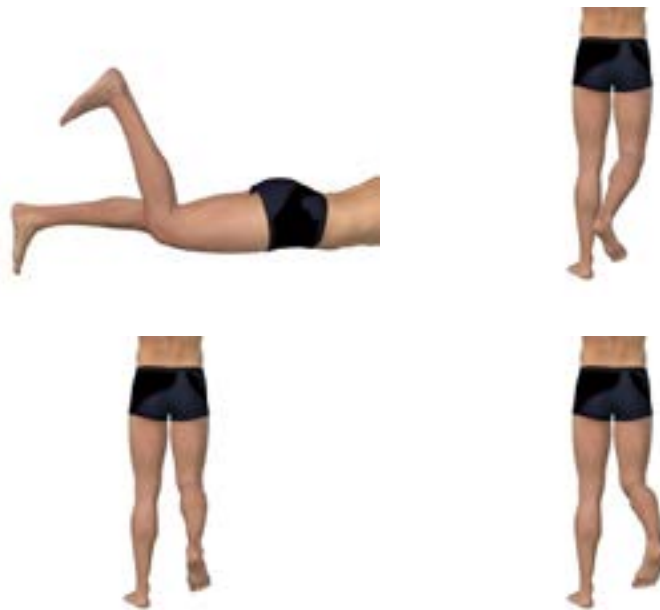
Contact

Grasp the lower leg proximal to the calcaneus taking care not to apply pressure over the Achilles' tendon or the malleoli. If testing the medial or lateral groups, the pressure is applied to the appropriate posterior medial or lateral surface of the leg.

Vector of Force

Pressure is applied against the lower leg at a tangent to the arc created by the motion of the foot as the knee is flexed.

Biceps femoris



Medial hamstring group



Nerve Supply L 4, 5 S 1 -2. Tibial branch of the sciatic nerve except for the short head of the biceps femoris which is supplied by the peroneal branch of the sciatic nerve (L 5 S - 1 - 2).

Synergists

Thigh extension: Gluteus maximus, posterior fibers of the adductor magnus and the gluteus medius

Knee flexion: Sartorius, gracilis, gastrocnemius

Medial rotation: (Medial hamstrings) Popliteus, sartorius, gracilis

Antagonists

Thigh extension: Rectus femoris, psoas, sartorius, TFL

Knee flexion: Quadriceps

Medial rotation: Lateral hamstrings

Lateral rotation: Medial hamstrings, Popliteus, sartorius, gracilis

Signs of inhibition

Imbalances in the medial or lateral heads of the hamstring will result in rotation of the thigh and tibia. This will result in either a genu valgus or varus stance. General weakness of the hamstrings will cause lack of posterior support to the pelvis and result in an anterior rotation of the innominate. This will cause the appearance of a relatively high pelvis on the side of weakness.

Strain counterstrain

The trigger point is palpated and the knee is then flexed fully. The leg is then elevated approximately 20 or more degrees and supported. The lower leg is then rotated medially or laterally depending on the muscle involved to reduce the tenderness of the trigger point.

Common Recruitment - Testing Errors

Pressure is applied in a downward direction abnormally increasing the relative strength of the subject or in an angle up towards the ceiling that creates an impression of weakness where non exists.

Plantarflexion of the foot causes facilitation..

Grasping the heel can cause pain.

Comments

The hamstrings are easily cramped if the testing position is wrong. Make sure to keep the starting position of the lower leg at an angle that is less than 90 degrees flexion. Applying pressure in the belly of the muscle during the test aids in limiting the cramping of the muscle.



Trigger Points

Referred Pain



Common Recruitment

Gluteus Maximus

Origin

The gluteus maximus arises from the posterior ilium, the posterior iliac crest, the postero-lateral surface of the sacrum, the lateral margin of the coccyx, the sacrotuberous ligament and the fascia of the gluteus medius.

Insertion

The muscle fibers traverse laterally and inferior to insert into the gluteal tuberosity of the femur and the iliotibial band of the tensor fascia lata.

Action

Non-weight bearing, contraction extends and laterally rotates the thigh. The upper fibers aid in abduction of the thigh. It functions during walking only with long strides as in running or in jumping. It functions along with the hamstring to decelerate the leg when using a long stride and aids in stabilization of the knee after heel strike.

Position of body part

With the subject prone, the knee is flexed at least 90 degrees. The femur is then extended until the pelvis begins to roll laterally. The leg is then lowered until the pelvis is flat on the table.

Stabilization

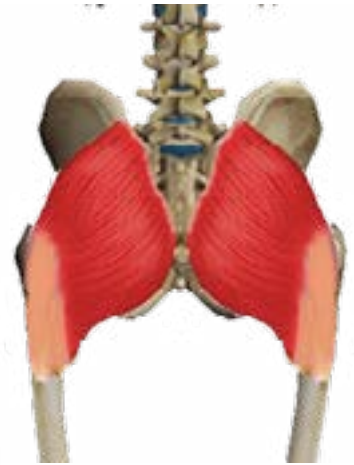
Pressure either is applied over the pelvis to prevent rolling or is used to prevent extension of the knee, which would allow recruitment of the hamstrings.

Contact

A flat contact is made over the hamstring just proximal to the popliteal space.

Vector of Force

Pressure is applied against the leg at a tangent to the arc created by the motion of the leg as it is extended. The pressure is anterior and slightly inferior.



Nerve Supply L – 5 S - 1 & 2.
Inferior gluteal nerve.

Synergists

Trunk extension: Hamstrings, sacrospinalis and quadratus lumborum
Thigh extension: Hamstrings, posterior gluteus medius
Lateral thigh rotation: Piriformis
Sacroiliac stability: Piriformis

Antagonists

Trunk extension: Psoas, rectus femoris
Thigh extension: Rectus femoris, psoas, sartorius
Lateral thigh rotation: Tensor fascia lata, adductors

Signs of inhibition

Visible atrophy of the muscle is often found.
Difficulty in arising from sitting without pushing off with their hands on their legs or the arms of a chair. In a unilateral inhibition is present, there may be anterior rotation of the innominate with an apparent high hip. Chronic weakness is associated with lateral knee instability on weight bearing due to the decreased support to the iliotibial band..

Strain counterstrain

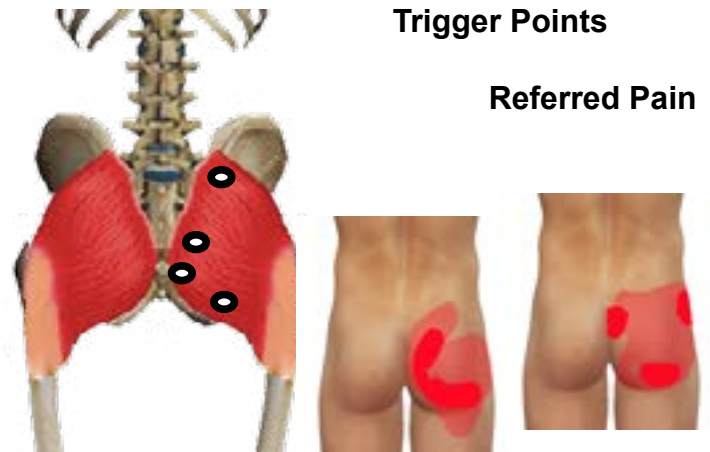
With the subject in a prone position, the leg is extended slowly while palpating for a reduction in the tenderness of the trigger point. The leg is then rested on the examiners thigh, which is placed under the subjects elevated leg. The leg may need to be abducted slightly to find the position of greatest reduction in tenderness.

Common Recruitment - Testing Errors

The most common error is when the subject is allowed to recruit the hamstrings by extending knee below 90 degrees. The second most common error is when the testing pressure is applied directly anterior. Another common error is when the subject is allowed to roll the pelvis.

Comments

This muscle is often the cause of a hypertonic piriformis that causes the piriformis syndrome. In these cases, the subject will present with signs of sciatic irritation that would normally be associated with a protrusion of the lower lumbar discs.



Common Recruitment

Gluteus Medius

Origin

The gluteus medius arises from the external surface of the ilium from the anterior 3/4 of the iliac crest.



Insertion

Insert into the lateral surface of the greater tuberosity of the femur.



Action

It is the primary abductor of the femur.

The majority of the stabilization of the pelvis on the femur as the weight is being transferred over the foot at mid stance is provided by the gluteus medius with assistance from gravity. The gluteus medius also assists in medial rotation of the thigh.

Position of body part

The subject is side lying with the lower leg flexed and the knee bent at 90 degrees for stability. The extended upper leg is abducted fully. The leg is kept in line with the pelvis. To isolate various fibers the leg is flexed or extended slightly.

Stabilization

Pressure is applied over the iliac crest to stabilize and prevent any rotation of the pelvis.

Contact

A flat contact is made over the lower leg proximal to the malleoli on the lateral aspect of the leg.

Vector of Force

Pressure is applied against the leg at a tangent to the arc created by the motion of the leg as it is abducted.

Neutral test- side lying



Anterior fibers

Posterior fibers



Nerve Supply L 4 - 5 & S - 1.
Superior gluteal nerve.

Synergists

Thigh abduction: Tensor fascia lata, sartorius, piriformis, gluteus maximus

Antagonists

Thigh abduction: Adductors
Pelvic rotation: Abdominal obliques

Signs of inhibition

Chronic sacroiliac instability.
Chronic pain over the trochanter.
Pain on prolonged walking.
Balance problems while wearing heels.

Strain counterstrain

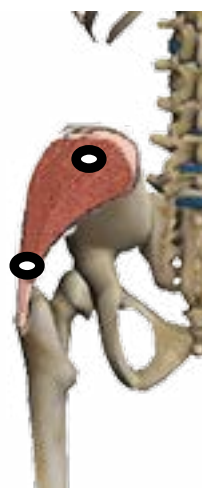
The subject is side lying on the non-involved gluteus medius. The trigger point is palpated and the leg is then abducted with slight flexion or extension of the leg depending on the location of the trigger point.

Common Recruitment - Testing Errors

The most common error is when the testing pressure is applied straight down instead of in an arc. The next most common error is when the leg is not fully abducted so the test is more of the tensor fascia lata.

Comments

In the side lying position, the muscle may test inhibited due to a piriformis syndrome. If this is suspected, pressure can be applied by the stabilizing hand to approximate the sacroiliac joint and the gluteus medius is then tested for strengthening while this pressure is applied.



Trigger Points

Referred Pain



Common Recruitment

Gastrocnemius

Origin

Medial head: Medial condyle of the femur
Lateral head: Lateral condyle of the femur

Insertion

Both heads of the gastrocnemius, as well as fibers of the soleus, join to the Achilles' tendon that attaches to the posterior surface of the calcaneus

Action

The major muscle responsible for plantar flexion of the foot. It also aids in posterior knee support. Relaxation of the gastrocnemius and the soleus begins the walking process by allowing the center of gravity to move anterior. Contraction of the gastrocnemius assists in flexion at the knee.

Position of body part

The subject is prone with the knee extended. The subject is asked to plantar flex the foot fully. This test is for the gastrocnemius and the soleus. It is not possible to completely isolate the gastrocnemius in this test. The soleus can be isolated from the gastrocnemius by flexing the knee 90 degrees.

Stabilization

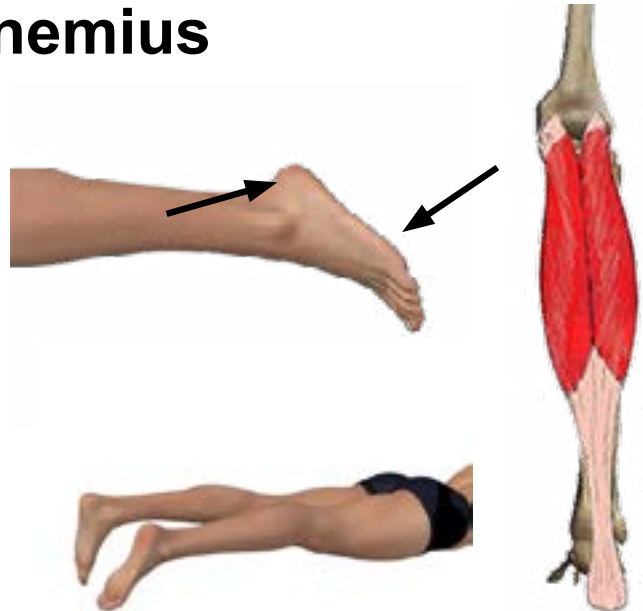
If tested either supine or prone none is needed.
If the muscle is tested in a standing position, then the femur will need support.

Contact

Grasp the foot firmly with both hands avoiding bony contacts on the foot.

Vector of Force

Pressure is applied to dorsiflex the foot.



Nerve Supply S - 1 & 2. Tibial nerve.

Synergists

Plantar flexion: Soleus, peroneus longus and brevis, tibialis posterior

Knee flexion: Hamstrings, gracilis, sartorius, popliteus

Antagonists

Plantar flexion: Tibialis anterior, peroneus tertius

Knee flexion: Quadriceps

Signs of inhibition

When the gastrocnemius is weak bilaterally, the subject will stand with an anterior lean to the body. If the gastrocnemius is strained and weak, the subject may stand with hyperextension of the knee. In lumbar disc problems, there will be an inability to rise on the toes

Strain counterstrain

With the subject prone, the knee is bent past 90 degrees and the foot is placed into full plantar flexion. The tibia and foot are then rotated to find the position of the greatest reduction in tenderness.

Common Recruitment - Testing Errors

Allowing the patient to flex the toes.

In the supine test, the patient will pull the foot into the table.

Comments

This muscle is very seldom found weak when tested in the classic test. Testing of the heads of the gastrocnemius in the supine position reveals more weakness patterns. The gastrocnemius is often found not to inhibit in the appropriate gait position. This failure of normal inhibition causes the increased tonus associated with the cramping syndrome.

Trigger points in the muscle maybe related with nocturnal cramps

Trigger Points

Referred Pain



Common Recruitment

Soleus

Origin

Arises from the posterior surface of the head of the fibula and to the proximal 1/3 of the posterior surface of the fibula.

Insertion

Joins to the Achilles tendon with the fibers of the gastrocnemius which attaches to the posterior surface of the calcaneus.

Action

Plantar flexes the foot.

Begins the walking process by relaxing to allow the center of gravity to move anterior. Aids in the stabilization of the tibia on the talus.

It is a musculovenous pump.

Position of body part

The subject is prone with the knee flexed at 90 degrees. This removes the gastrocnemius from the test. The subject is asked to plantarflex the foot fully.

Stabilization

Due to the strength of the muscle none is needed unless the muscle is tested in a standing position. Then the tibia will need support.

Contact

Grasp the foot firmly with both hands avoiding bony contacts on the foot.

Vector of Force

Pressure is applied to dorsiflex the foot.



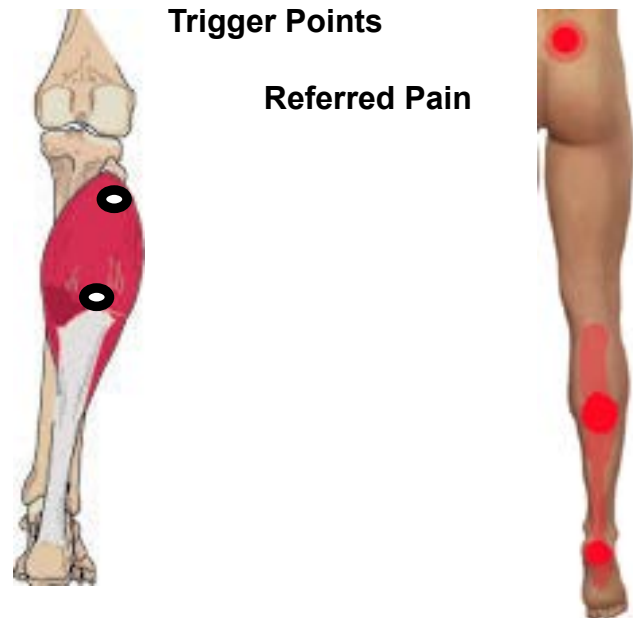
Nerve Supply S - 1 & 2. Tibial nerve.

Synergists

Plantarflexion: Gastrocnemius, peroneus longus/brevis, tibialis posterior

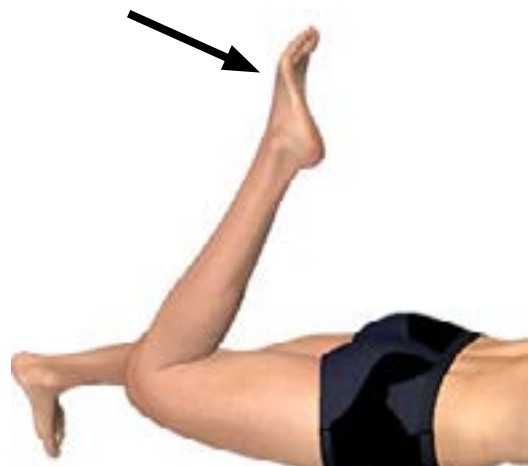
Antagonists

Plantarflexion: Tibialis anterior, peroneus tertius



Signs of inhibition

The subject will stand with an anterior lean to the body.
Inability to rise on the toes.



Strain counterstrain

First, flex the knee to relax the gastrocnemius so that the soleus can be palpated. Once the area of tenderness has been localized, continue to flex the knee and plantarflex the foot until the tenderness has been reduced.

Common Recruitment - Testing Errors

Squeezing the foot and creating pain.

Comments

This muscle is very seldom found weak. It is however often found not to inhibit in a gait position. This failure of normal inhibition causes the increased tonus associated with the cramping symptom.

A failure of adequate contraction of the tibialis anterior can cause a failure of the muscle to inhibit properly.

Chronic contraction of the muscle leads to heel spurs and other calcaneus problems.



Common Recruitment

Popliteus

Origin

From the lateral condyle of the femur, the joint capsule of the knee, the lateral meniscus and the head of the fibula.

Insertion

Inserts on the posterior surface of the tibia, just proximal to the soleal line.

Action

Rotates the tibia medially when the femur is fixed. When the foot and ankle are fixed, it rotates the femur laterally. On heel strike, the muscle contracts to unlock the knee to absorb shock. When the knee is flexed, the muscle pulls the lateral meniscus withdrawing it. The muscle stabilizes the posterior aspect of the knee.

Position of body part

The knee is flexed at 90 degrees and the foot is maintained at 90 degrees in relation to the tibia. The tibia is then fully medially rotated. The muscle can be tested in the sitting, prone or supine position.

Stabilization

The femur is stabilized by the patient sitting or lying on the table.

Contact

A dual hand contact is used grasping the foot firmly avoiding any bony contacts. The hand around the heel should also contact the malleoli. This contact allows the tester to feel for any motion of the foot on the ankle. When weak, the tester will feel the malleoli rotate.

Vector of Force

Pressure is applied to the foot to rotate the tibia laterally. Weakness is when the tibia rotates on the femur.



Nerve Supply L - 4, 5 & S - 1. Tibial nerve.

Synergists

Medial rotation: Medial hamstrings
Knee flexion: Hamstrings, gracilis, sartorius, gastrocnemius

Antagonists

Medial rotation: Lateral hamstrings
Knee flexion: Quadriceps

Signs of inhibition

The subject will stand with the knee in hyperextension or with the knee flexed.
There is tenderness behind the knee in the popliteal space.
Testing shows inhibition of the rectus femoris or of the vastus muscles.

Strain counterstrain

The knee is bent 90 degrees and the tibia and fibula are internally rotated.

Common Recruitment - Testing Errors

The most common error is done by squeezing the foot and creating pain. This muscle should be tested only after ascertaining that there is integrity of the ankle joint. A weakness of the tibialis posterior prohibits proper testing of this muscle.

Comments

The muscle is strained in hyperextension injuries of the knee. In these cases, the tibia/femur relationship is compromised. This applies additional stress on the tendon of the quadriceps. In mild cases, the rectus femoris will test weak. In severe cases, the vastus will also test weak.

Contraction of this muscle prevents forward dislocation of the femur on the tibia or posterior motion of the tibia under the femur.



Common Recruitment

Tibialis Anterior

Origin

The tibialis anterior arises from the lateral condyle and upper 2/3 of the lateral surface of the tibia, the interosseous membrane, the crural fascia and the intermuscular septum.

Insertion

The tibialis anterior inserts into the medial plantar surface of the medial cuneiform and the base of the first metatarsal.

Action

Contraction of the tibialis anterior elevates the foot during the swing phase of gait.

It causes dorsiflexion of the foot at the talocalcaneal joint. Contraction also causes inversion of the subtalar joint..

Position of body part

The patient is asked to pull their foot towards their nose. This is accomplished by fully contracting the tibialis anterior.

Decreased dorsiflexion can be due to shortening of the gastrocnemius. If found, flex the knee 90 degrees and have the patient dorsiflex the foot for testing.

Stabilization

Pressure is applied against the lower leg above the malleoli.

Contact

Grasp the foot using the full hand. Avoid excessive force over the first metatarsal joint or over the great toe.

Vector of Force

Pressure is applied through the broad contact in the direction of plantarflexion and slight eversion at a tangent of the arc created by the motion of the foot.



Nerve Supply L - 5 and S - 1 Tibial nerve.

Synergists

Dorsiflexion: Extensor digitorum longus, extensor hallucis longus and the peroneus tertius

Antagonists

Dorsiflexion: Gastrocnemius, soleus, peroneus longus and brevis, tibialis posterior, toe flexor muscles.

Signs of inhibition

Foot drop or slapping of the foot at heel strike.
Tripping over objects as the foot clearance with the ground is diminished.
Loss of anterior support while leaning backwards in the standing position.

Strain counterstrain

After locating the tender area, the foot is placed in full dorsiflexion and the foot is then rotated into inversion to find the position of the greatest reduction in tenderness.

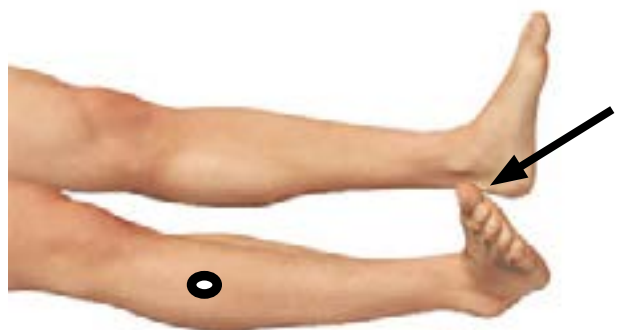
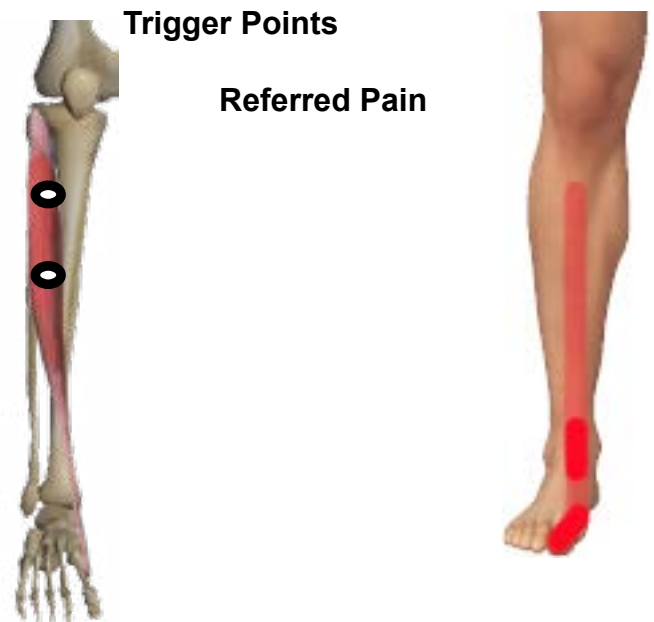
Common Recruitment - Testing Errors

Excessive pressure is applied over the first metatarsal creating pain. Bony parts of the testers hand are used. Patient recruits using the toe extensor muscles to further facilitate the contraction of the tibialis anterior.

Comments

In cases of suspected disc involvement, always test this muscle in the sitting position before testing in the supine position.

Decreased dorsiflexion is usually associated with a hypertonic gastrocnemius/soleus group that fails to inhibit with the contraction of the tibialis anterior. A hypertonic tibialis anterior may effectively cause reflex inhibition of the psoas and possibly the vastus group resulting in a short stride.



Common Recruitment

Tibialis Posterior

Origin

Medial surface of the fibula, the interosseous membrane, the lateral portion of the posterior surface of the body of the tibia, the deep transverse fascia and the intermuscular septa

Insertion

Mainly to the plantar surface of the navicular but also to the plantar surfaces of the calcaneus, cuboid, all cuneiforms and to the base of the second to fourth metatarsals.

Action

The major muscle involved in inversion and aids in plantar flexion of the foot. Basically, it supports the arch elevating the navicular and in doing so, prevents excessive pronation during active walking. During static standing, the muscle is usually not active. It aids in the even distribution of weight across the metatarsals.

Position of body part

The subject is asked to fully plantar flex the foot and then fully invert the foot. Care is taken to keep the foot in full plantarflexion.

Stabilization

Pressure is applied on the lower leg above the malleoli, and the thumb is placed over the tendon of the tibialis anterior to feel for elevation of the tendon.

Contact

Grasp the foot using the full hand. Avoid excessive force over the first metatarsophalangeal joint or over the great toe. Pressure is applied to keep the foot in full plantarflexion.

Vector of Force

Pressure is applied through the broad contact in the direction of eversion. This force is from inferior to superior and medial to lateral in an arc.



Nerve Supply L - 5 and S - 1 Tibial nerve.

Synergists

Non weight bearing: Flexor digitorum & hallucis longus

Weight bearing:

Inversion: Tibialis anterior, Extensor hallucis longus

Plantar flexion: Gastrocnemius, soleus, peroneus longus & brevis

Antagonists

Inversion: Peroneus longus & brevis

Plantar flexion: Tibialis anterior, Peroneus tertius

Signs of inhibition

Pronation of the foot.

The next most common sign will be an expansion of the metatarsals that may cause metatarsalgia. This may cause weakness of the flexor hallucis brevis in a standing weight bearing position.

During the end of the swing phase of gait the foot remains externally rotated.

Strain counterstrain

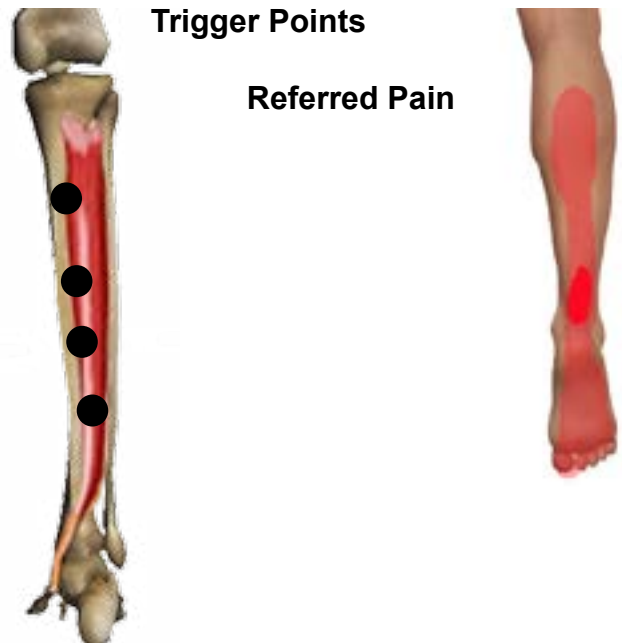
After finding the tender area on the posterior of the medial tibia, the foot is pushed into dorsiflexion and inversion.

Common Recruitment - Testing Errors

Excessive pressure is applied over the first metatarsal creating pain. Bony parts of the testers hand are used. Patient recruits using the tibialis anterior muscle as evidenced by elevation of the tendon.

Comments

During walking and running, this muscle helps prevent valgus strain on the lower leg and ankle. As the weight transfers across the foot, contraction of the muscle prevents excessive pronation that causes tibial medial rotation that stresses the knee and femur head in the acetabulum.



Common Recruitment

Peroneus Longus and Brevis

Origin

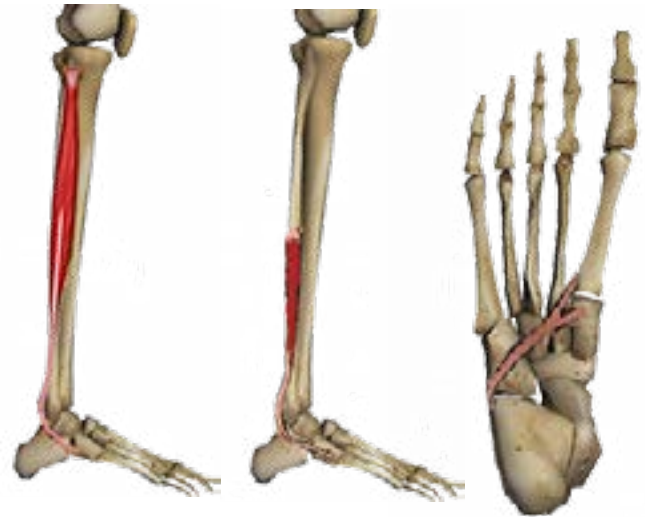
Longus: Fibular head, superior 2/3 of the lateral surface of the fibula and the intermuscular septa

Brevis: From the distal 2/3 of the fibula lateral surface intermuscular septa.

Insertion

Longus: Into the ventral and lateral aspects of the 1st metatarsal and the medial cuneiform

Brevis: Into the tuberosity on the lateral aspect of the 5th metatarsal



Action

Non-weight-bearing, these muscles evert and plantar-flex the foot. Weight-bearing they stabilize the foot and leg in midstance by aiding in the medio-lateral control of weight balance. The peroneus longus works in coordination with the tibialis posterior. The tibialis posterior and the peroneus longus support the metatarsal arch.

Position of body part

The subject is asked to fully plantar flex the foot and then fully evert the foot.



Stabilization

Grasp the lower leg above the malleoli with one finger or thumb placed over the tendon of the tibialis anterior to feel for contraction.

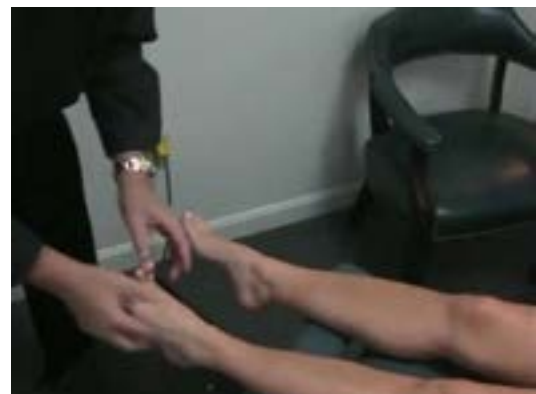


Contact

Grasp the foot using the full hand. Avoid excessive force over the fifth metatarsal joint or over the little toe. Pressure is also applied with the testing hand to prevent dorsiflexion.

Vector of Force

Pressure is applied through the broad contact from inferior to superior and lateral to medial in an arc. Restraining and dorsiflexion of the foot.



Nerve Supply L - 4, 5 and S - 1
Superficial peroneal nerve.

Synergists

Eversion: Peroneus tertius
Plantar flexion: Gastrocnemius, soleus,
tibialis posterior

Antagonists

Eversion: Tibialis anterior, tibialis posterior
Plantar flexion Tibialis anterior, peroneus tertius

Signs of inhibition

Internal rotation of the foot (toe in) walking.
Loss of lateral stability when the weight shifts forward
over the foot at the initiation of the walking process.
Excess inversion of the foot during the swing phase
of gait.

Strain counterstrain

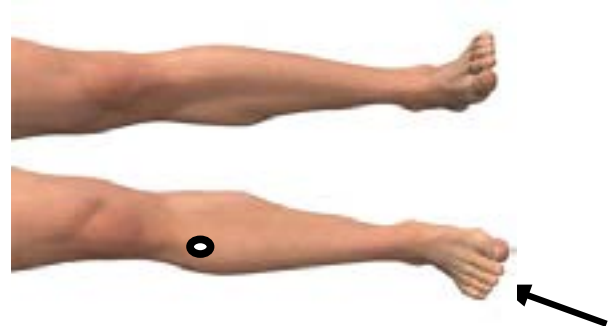
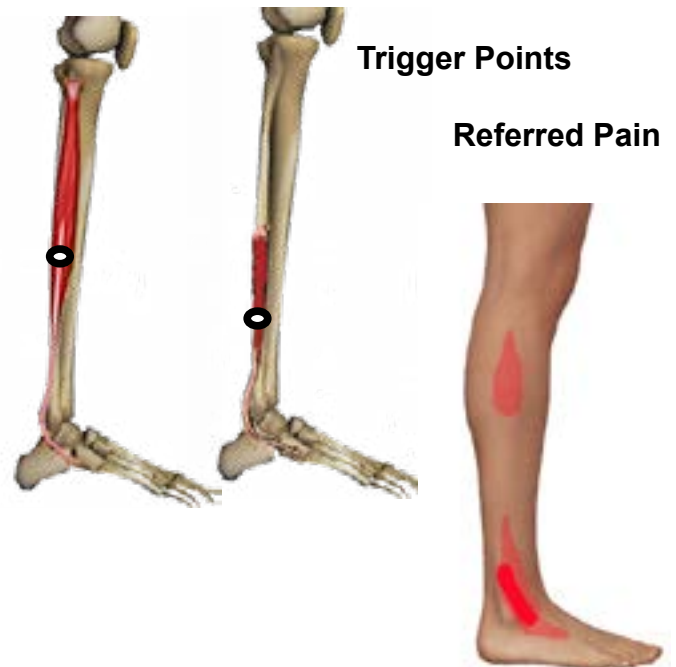
After finding the tender area in the muscle, the foot is
in plantarflexion and then everted. The angle of the
foot is altered until the tenderness is dramatically re-
duced.

Common Recruitment - Testing Errors

Excessive pressure is applied over the fifth metatarsal
creating pain.
Bony parts of the hand are used causing discomfort
to the patient.
Allowing recruitment of the tibialis anterior muscle.

Comments

The peroneus longus and brevis are important in
the lateral support to the ankle and foot. Weakness
of these muscles may be caused by a separation of
the tibia and fibula that stresses the intermuscular
septa. Approximating and supporting the tibia and
fibula just below the head of the fibula may increase
the strength of these muscles.



Common Recruitment

Peroneus Tertius

Origin

Distal 1/2 of the anterior margin of the fibula and the intermuscular septa.

Insertion

Tubercle of the fifth metatarsal.

Action

Non-weight-bearing, the muscle everts and dorsiflexes the foot.

Weight-bearing, it stabilize the foot and leg after heel rise as the weight starts to shift anterior and aids in the medio-lateral control of weight balance.

Position of body part

The subject is asked to fully dorsi flex the foot and then fully evert the foot. The toes are then flexed fully to prevent contraction of the toe extensors.

Stabilization

Pressure is applied above the malleoli grasping the lower leg.

Contact

Grasp the foot using the full hand. Place part of the hand against the toes to feel for any recruitment of the extensor muscles

Vector of Force

Pressure is applied through the broad contact in the direction of plantar flexion and inversion. This force is from superior to inferior and lateral to medial in an arc.



Nerve Supply L - 5 and S - 1
Deep peroneal nerve.

Synergists

Eversion: Peroneus longus and brevis
Dorsi flexion: Tibialis anterior

Antagonists

Eversion: Tibialis anterior, tibialis posterior
Dorsi flexion: Tibialis posterior, peroneus longus and brevis

Signs of inhibition

Internal rotation of the foot (toe in) walking.
Loss of lateral stability when the weight shifts forward over the foot at the initiation of the walking process.

Strain counterstrain

After finding the tender area in the muscle, the foot is in dorsiflexion and then everted. The angle of the foot is altered until the tenderness is dramatically reduced.

Common Recruitment - Testing Errors

Excessive pressure is applied over the fifth metatarsal creating pain. Bony parts of the testers hand are used. Recruitment of the toe extensors.

Comments

The peroneus tertius, if weak, will cause a slight “flick” of the foot to the lateral as you bring the weight forward and lift the heel. Weakness may also be a cause of loss of lateral support to the foot at heel strike.

Lateral malpositions of the cuboid have been associated with reflex weaknesses of the peroneus tertius. These are easily tested for by applying medial pressure against the cuboid while retesting the strength of the peroneus tertius.



Common Recruitment

Flexor Hallucis Longus & Brevis

Origin

Longus: Inferior 2/3 of the fibula, the intermuscular membrane and intermuscular septa

Brevis: Adjacent surfaces of the cuboid and lateral cuneiform and fibers of the tibialis posterior

Insertion

Longus: Base of the terminal phalanx of the great toe

Brevis: Medial and lateral surfaces of the base of the proximal phalanx of the great toe

Action

Longus: Flexion of the distal phalanx. Assists in plantar flexion and inversion of the foot. Aids in stabilization from mid stance on in walking.

Brevis: Flexion of the proximal phalanx.

Position of body part

The foot is placed slightly plantar-flexed. The patient is instructed to flex the great toe.

To test strength at toe off, the foot is fully plantarflexed.

Stabilization

The foot is supported.

Longus: stabilize the proximal phalanx.

Brevis: the joint between the distal and proximal phalanges is straightened

Contact

Longus: the distal phalanx is contacted with the thumb on the plantar surface

Brevis: the distal and proximal phalanges are contacted and pressure is applied to flex the proximal joint.

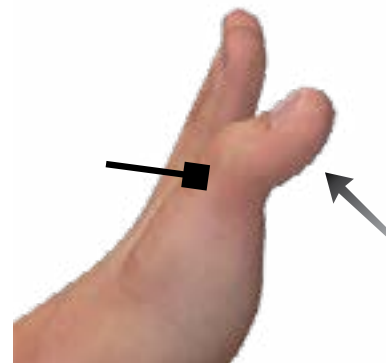
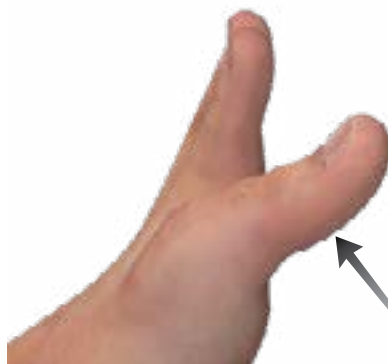
Vector of Force

Longus: pressure is exerted to extend the distal phalanx on the proximal phalanx

Brevis: pressure is applied to extend the proximal phalanx on the first metatarsal.



Flexor hallucis brevis



Flexor hallucis longus



Nerve Supply Longus from L - 5 to S-2
brevis from mostly L5 and S-1

Synergists

These two muscles are synergists to each other.

Toe flexion: Flexor digitorum longus and brevis.

Plantarflexion: Gastrocnemius, soleus, tibialis posterior, peroneus longus/brevis

Antagonists

Flexion: Long and short extensors of the toes

Plantar flexion: Tibialis anterior and peroneus tertius

Referred Pain



Signs of inhibition

Failure to “toe off” when walking.

Claw formation of the great toe.

Lack of stability as the weight is transferred to the front of the foot.

Formation of a “bunion”.

Strain counterstrain

For the brevis, palpate the muscle and then flex the great toe to find the position that reduces the tenderness. The longus is hard to palpate. If it is suspected, with the patient prone, plantarflex the foot and fully flex the great toe and the distal phalanx.

Common Recruitment - Testing Errors

Excessive pressure is applied over the first metatarsophalangeal joint.

Comments

The brevis receives its innervation after the tarsal tunnel so entrapment of the medial plantar nerve will lead to weakness of the muscle.

The hallucis muscles should also be tested in a weight bearing position. When tested in this fashion, hidden weakness patterns will be found. These are associated with a weak tibialis posterior as it fails to support the navicular and the arch. You may have to have the subject shift their weight anterior over the foot to uncover the hidden weakness.

Flexor hallucis brevis



Flexor hallucis longus



Extensor Hallucis Longus & Brevis

Origin

Longus: Mid section of the anterior surface of the tibia and the interosseous membrane

Brevis :From the lateral talocalcaneal ligament and the inferior extensor retinaculum

Insertion

Longus; Base of the distal phalanx of the great toe

Brevis Base of the proximal phalanx of the great toe

Action

Contraction of the brevis extends the proximal phalanx of the great toe and the longus the distal phalanx

Position of body part

The foot is placed in a neutral position, or the muscles can be tested in a standing posture.

The patient is instructed to extend the great toe.

Stabilization

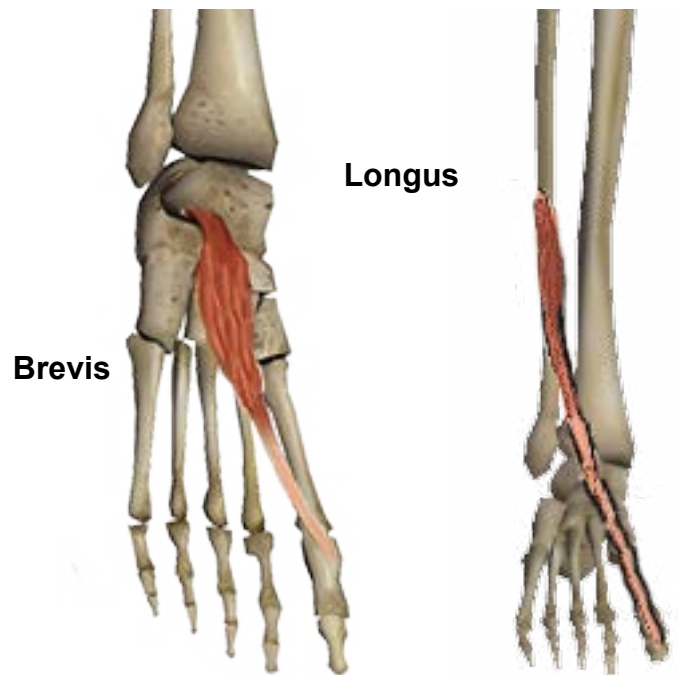
If standing, the weight of the body stabilizes the foot. Non-weight bearing, contact and support the first metacarpal phalangeal joint.

Contact

Make a soft contact on the proximal or distal phalanx of the great toe depending on which muscle is to be tested.

Vector of Force

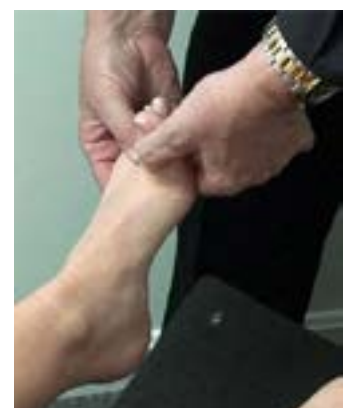
Pressure is applied to flex the proximal and/or distal phalanx on the first metatarsal.



Longus



Brevis



Nerve Supply Longus from L - 4 to S-1
Brevis from mostly L5 and S-1

Synergists

The muscles are synergistic with each other and with the other toe extensors.

The muscles are involved with dorsiflexion of the foot. They work with tibialis anterior and the peroneus tertius.

Antagonists

Toe extension: Flexor hallucis longus and brevis

In foot dorsiflexion the antagonists also include the gastrocnemius, soleus, tibialis posterior and the peroneus longus as well as the other toe flexors

Signs of inhibition

Tripping
Scuffing of the foot

Strain counterstrain

For the brevis, palpate the muscle and then extends the great toe to find the position that reduces the tenderness. For the longus dorsiflex the foot and fully extend the great toe .

Common Recruitment - Testing Errors

Applying pressure against an inflamed 1st MTP joint.

Using excessive pressure

Comments

The longus receives its nerve supply proximal to the talus while the brevis does distal to the talus. Anterior movement of the talus can cause entrapment and inhibition of the brevis. When this occurs, an anterior tarsal tunnel, the distal fibula and tibia will be partially separated. There maybe cramping of the muscle if trigger points are found.



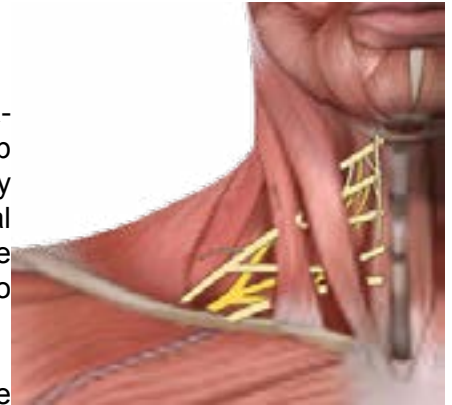
Muscle Testing and Upper Extremity Peripheral Nerve Entrapments

Muscle testing can be used as a diagnostic key to determine the existence of peripheral nerve entrapments. This paper discusses the basic entrapment syndromes of the upper extremity and the related findings using muscle testing.

In examining a patient, symptoms in the upper extremity are often confused and improperly related to a spinal causative factor. Especially following any fall or automobile accident the upper extremity must be examined for peripheral; entrapment syndromes. The major entrapment syndromes are presented here with their symptomatic picture and muscle testing findings.

Anterior Scalene Syndrome

Compression of the brachial plexus, the subclavian artery and the subclavian vein between the anterior and medial scalene muscles and the first rib can cause symptoms throughout the arm. The muscle fibers, if continually contracted or hypertrophied, first affect the lower sections of the brachial plexus. When this becomes chronic, the entire plexus, composed of nerve roots from C - 5 to T - 1 can be affected. Vascular symptoms occur due to the compression of the artery and/or vein.



Symptoms reported by the patient will usually begin with numbness in the hand and fingers radiating up into the forearm, pain from the shoulder to the hand and cold hands with symptoms similar to Raynaud's phenomenon. The entrapment of the brachial plexus causes sensory symptoms on the ulnar side of the hand. Travell reports that trigger points in the scalene muscles will cause referred pain on the radial aspect of the hand. On inspection, the small muscles of the hand may appear to have atrophied.

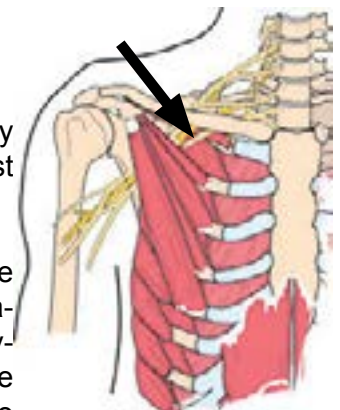
Muscle testing will usually reveal no overt signs of inhibition unless the anterior scalenes are stressed. The stress is applied by varying the position of the patient, standing, leaning over, and fully inspiring or having the patient elevate the head while lying supine. Examination of the anterior scalene will uncover an intact muscle that has trigger points. These are usually the result of another inhibited muscle. Frequently the latissimus dorsi is found involved.

If inhibition is found in the arm with the patient sitting or standing, raising the arm above the shoulder with anterior rotation of the shoulder elevates the clavicle reducing any neurovascular entrapment. This same position can be used in the following three syndromes to decompress the neurovascular bundles.

Costoclavicular Syndrome

This syndrome refers to entrapments of the brachial plexus, the subclavian artery and/ or the subclavian vein as they traverse beneath the clavicle and over the first rib.

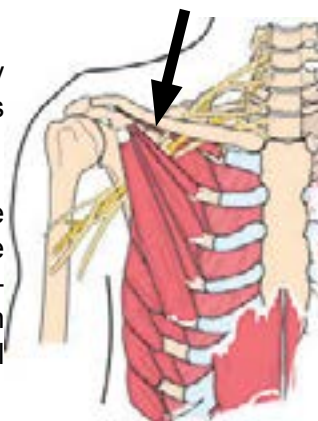
Symptoms of entrapment are usually transient and brought on by motions of the clavicle or the first rib. The symptomatic pattern is the same as in the anterior scalene syndrome. Muscle testing will reveal no overt inhibition patterns until the clavicle or the first rib is stressed. Hand muscles can be tested for inhibition. There are two different positions that can elicit a inhibition pattern. First, the arm is flexed to 140 degrees and arm or hand muscles are tested. This motion rotates the clavicle involving the subclavius muscle. The shoulder can also be rotated posteriorly with the arm extended to 30 degrees. This shoulder position is similar to the position used in the military. Finally, the patient is asked to fully inspire. This activates the scalene muscles elevating the first rib. If the clavicle has been displaced inferiorly or the first rib is superior a inhibition pattern will be created in the arm.



Pectoralis Minor Syndrome

In this syndrome, neurovascular entrapment of the brachial plexus, the axillary artery and the subclavian vein can occur between the fibers and tendon of the pectoralis minor muscle, the head of the humerus and the coracoid process of the scapula.

Symptoms of entrapment are usually transient. The symptomatic pattern is the same as in the anterior scalene syndrome. However, these patients have more vascular symptoms as well as signs of lymphatic blockage. This differs from the scalene involvement where venous blockage is paramount. Commonly, this is found in people who work over their heads or who have excessively developed the pectoral muscles.



Symptoms are aggravated by sleeping with the arm elevated or by carrying heavy objects

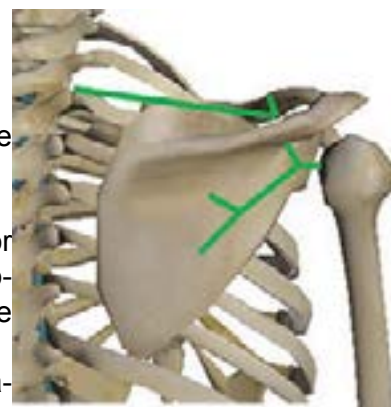
The classical test for entrapment of the axillary artery is the Wright maneuver where the arm is placed in external rotation and the shoulder is abducted. This same position will elicit inhibition if the costoclavicular syndrome is present.

Muscle testing will reveal no overt inhibition patterns in some positions. Creation of the inhibition depends upon the contraction or relaxation of the pectoralis minor muscle. If the latissimus dorsi is inhibited allowing elevation and anterior rotation of the shoulder, the pectoralis minor will be shortened with trigger points in the belly of the muscle. In this case, testing in the standing or sitting posture will reveal inhibition of the hand muscles that will immediately strengthen if the arm is elevated above the horizontal with slight flexion of the arm. Care should be taken not to maximally elevate the arm, as that will cause the inhibition pattern to return.

Suprascapular Nerve Syndrome

This is a very commonly overlooked syndrome that can lead to atrophy of the infraspinatus and the supraspinatus muscles.

The suprascapular nerve is composed of fibers arising from either the C - 5 or C - 6 nerve roots. It traverses through the suprascapular fossa and the scapular notch to arrive at the supraspinatus fossa. After supplying fibers to the supraspinatus muscle, the acromioclavicular joint and the subacromial bursa, it twists around the base of the spine of the scapula and enters the infraspinatus fossa. Due to this tortuous path, the nerve is stretched as the scapula moves if there is any scapula instability.



Symptoms, reported by patients, will run the gamut from diffuse shoulder pain that is hard to localize to complete atrophy of the infraspinatus first and then the supraspinatus muscles. Symptoms are usually aggravated by any activity that requires extensive motion of the scapula.

In most cases, there is no overt inhibition pattern. However, if the scapula stabilizers are inhibited, especially the serratus anterior or rhomboids, the infraspinatus will test inhibited if tested with the arm flexed to 90 degrees with anterior rotation of the shoulder. This position creates additional torsion on the suprascapular nerve and if the scapula has inadequate support, the infraspinatus will be inhibited.

Pronator Teres Syndrome

This entrapment syndrome is of the median nerve as it passes between the ulnar and radial heads of the pronator teres muscle. After the nerve passes the pronator teres, it divides and supplies the flexor muscles of the wrist and hand except for the flexor carpi ulnaris and the ulnar portion of the flexor digitorum profundus.

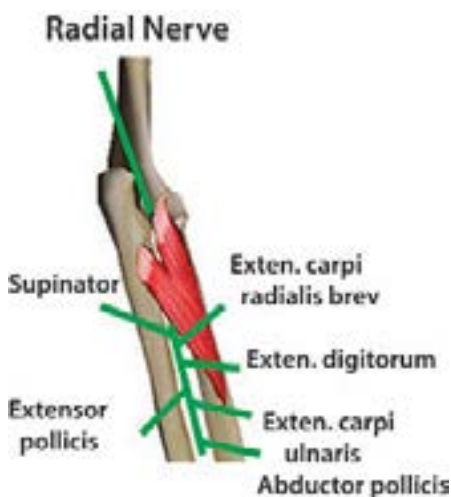
Symptoms reported by the patient will include loss of strength throughout the hand, difficulty writing, paresthesia throughout the hand and especially the palm.

Muscle testing will reveal inhibition of the finger flexors that resolves when the radius and the ulna are approximated just distal to the elbow.

Supinator Syndrome

In this entrapment syndrome the radial nerve becomes compromised as it passes beneath the supinator muscle.

Symptoms occur during repeated motions of the forearm. The throwing motion uses all of these.



These can include pronation, wrist flexion and forearm extension. The pain pattern is described as deep on the posterior aspect of the forearm.

Hand inhibition is reported.

The easiest muscle to test for this syndrome is the extensor carpi ulnaris. If it is found inhibited, the head of the radius is approximated to the ulna and the muscle is retested. The extensor carpi ulnaris can also be tested when the supinator is placed in a strain counterstrain position. This position fully relaxes the muscle.

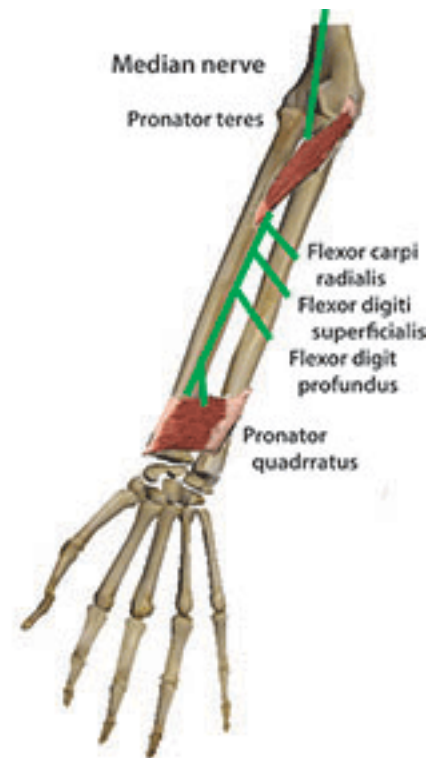
Ulnar Sulcus Syndrome

The ulnar nerve passes down the posterior surface of the humerus and passes through a sulcus on the medial epicondyle of the humerus. The epicondyle-olecranon ligament stabilizes the ulna and the humerus. It also stabilizes the ulnar nerve at the sulcus and prevents it from moving during forearm motions.

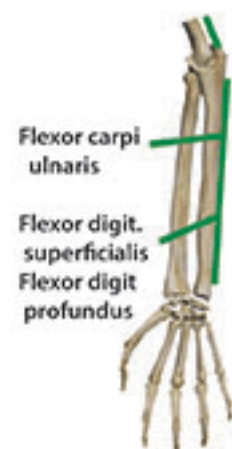
When the ligament is hypertrophied or stretched, entrapment of the ulnar nerve occurs. The nerve supplies the flexor carpi ulnaris, the ulnar portion of the flexor digitorum profundus, the interossei and hypothenar muscles, the adductor pollicis and the deep head of the flexor pollicis brevis.

Symptoms include paresthesia and pain over the ulnar nerve distribution and inhibition of the above muscles.

Testing of the flexor carpi ulnaris with the elbow first in extension and then in flexion may uncover entrapment of the ulnar nerve. If found, the relationship between the humerus and the ulna needs further inspection. Any chronic subluxation, dislocation or avulsion can create ulnar nerve entrapment. After correcting any imbalances, direct attention should be applied to the integrity of the ligament.



Ulnar Nerve



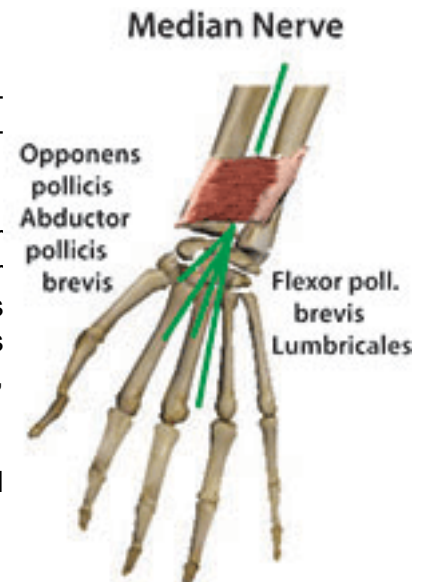
Carpal Tunnel Syndrome

This syndrome consists of compression of the median nerve at the fibrous-osseous canal at the wrist. The tunnel is formed by four major bony prominences, the pisiform, the navicular, the hamate and the trapezium.

Between these bony prominences runs the transverse carpal ligament. After this tunnel, the median nerve gives sensory branches to supply the palmar surfaces of the first and second fingers and motor branches to the opponens pollicis, abductor pollicis brevis and the superficial head of the flexor pollicis brevis. Compression of the contents of the tunnel can occur due to edema, local subluxation, fracture, etc

The patient reports symptoms ranging from paresthesia, thenar atrophy and inhibition. These symptoms worsen as the condition becomes chronic.

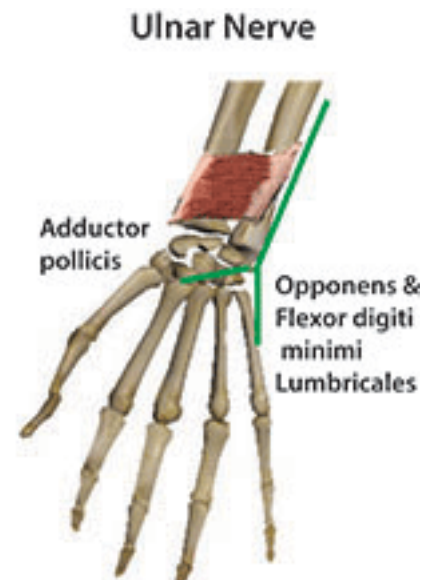
As noted above, the median nerve innervates the opponens pollicis muscle. Inhibition of this muscle becomes the diagnostic key to isolating the problem. The muscle should be tested with the forearm and wrist in a neutral position, full pronation, full supination, wrist extension and wrist flexion.



Ulnar Tunnel Syndrome

The ulnar nerve can become compressed at the level of the proximal carpal bones. This tunnel is bordered by the pisiform and the hamate as well as the transverse carpal ligament and the flexor carpi ulnaris muscle. There are two entrapment syndromes in this area. These correspond to the superficial and deep branches of the ulnar nerves that run through the ulnar tunnel. These nerves supply the sensory distribution to the palmar aspect of the fifth finger and the ulnar side of the fourth finger. The deep branch of the ulnar nerve supplies the interossei muscles the small muscles of the fourth finger and the adductor pollicis muscle.

Inhibition of either the flexor digiti minimi or the opponens digiti minimi muscles is the key that indicates entrapment of the ulnar nerve at the wrist. Once the inhibition is found, directional pressure is applied against the pisiform and the hamate until a vector is found that strengthens the inhibited muscle.



Review

Inhibition of the deltoid, especially the middle and posterior sections is commonly found in acromioclavicular strains. Severe thoracic outlet syndromes can entrap the superior sections of the brachial plexus creating inhibition in the deltoids and the teres minor.

Depicted here are the three muscles innervated by the musculocutaneous nerve in the upper arm. Inhibition of all three of these muscles, the coracobrachialis, biceps and the brachialis may indicate a thoracic outlet syndrome. These three muscles are innervated by the musculocutaneous nerve.

The ulnar nerve does not supply any muscles until it is well down the humerus

On the posterior aspect of the shoulder, the major missed entrapment syndromes involve inadequate stabilization of the scapula. As you can see, the suprascapular nerve supplies the supraspinatus before it bends and winds itself around the spine of the scapula.

Instability of the scapula, especially a loss of posterior support can lead to stretching of this nerve and sub-

sequent inhibition of the infraspinatus.

The axillary nerve supplies the deltoid and the teres minor muscles.

Before the nerve bifurcates to supply these muscles, branches are given off to the subscapularis, latissimus dorsi and the teres major muscles.

Again, these are primary muscles to be used in ascertaining the existence of a peripheral nerve entrapment in the area of the shoulder girdle.

As you progress farther down the arm, the pronator teres is the last muscle supplied superior to the elbow by the median nerve. Knowing the status of the pronator teres aids in diagnosing problems arising from entrapment syndromes inferior to the elbow. For example, if the flexor carpi radialis is inhibited and the pronator teres is facilitated, then the median nerve is involved at the elbow.

When the ulnar nerve is entrapped at the elbow, the flexor carpi ulnaris is the first muscle supplied inferior to the elbow.

The integrity of the muscle is important if the flexor digiti minimi or opponens digiti minimi is found inhibited. Inhibition of muscles above and below the carpal bones indicates an entrapment syndrome at the elbow and not just at the wrist.

When examining the radial nerve, important muscles to test include the supinator, the extensor digitorum muscles and the abductor and/or extensor pollicis muscles.

Entrapment syndromes as the radial nerve passes down the forearm will create inhibition patterns relative to the level of the first muscle found inhibited. Generally, all of these muscles will be inhibited if the radial nerve is entrapped. In the hand, inhibition patterns of the opponens pollicis, with a finding of strength in the muscles innervated superior to the wrist by the median nerve, indicates the probable presence of a carpal tunnel syndrome.

A common testing procedure will find the flexor digitorum superficialis and profundus strong and the opponens pollicis inhibited. If all three muscles are found inhibited, the entrapment syndrome is at the elbow or mid forearm.

Testing of the ulnar nerve at the wrist consists of testing for the relative strength of the opponens digiti minimi or the flexor digiti minimi in comparison with the strength of the flexor carpi ulnaris. If the flexor carpi ulnaris is inhibited along with the muscles of the fourth finger, then the ulnar nerve is entrapped at the level of the elbow or above. Inhibition of the finger muscles in the presence of strength of the flexor carpi ulnaris indicates a problem of entrapment at the level of the carpal bones. Note the innervation of the adductor pollicis. Improper testing of the opponens pollicis will result in recruitment of the adductor pollicis and erroneous findings.

Conclusions

Muscle testing is an art as well as a science. One of the best uses of muscle testing is in aiding your examination procedures.

Reproducible results depend on consistent testing. This testing must not only be reproducible from one examination of another, but must also be done accurately. A common error is improper testing of the opponens pollicis muscle. If this test is properly performed, you are testing median nerve function. If the test is done improperly, you could be testing the ulnar nerve or a combination test that would challenge the integrity of the median as well and the ulnar nerve.

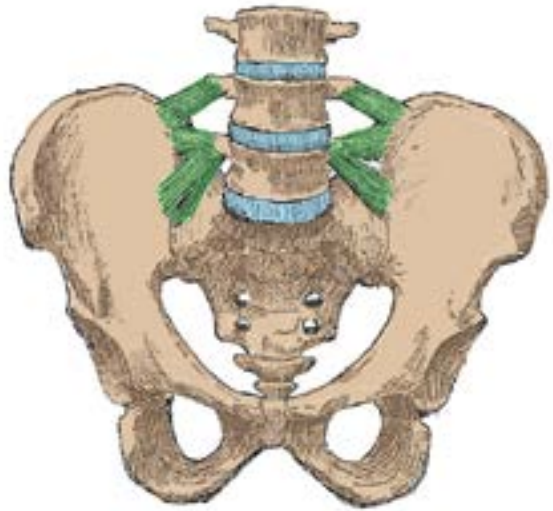
Muscle Testing and Lower Extremity Peripheral Nerve Entrapments

Introduction

In examining a patient, symptoms in the upper extremity are often confused and improperly related to a spinal causative factor. Especially following any fall or automobile accident the upper extremity must be examined for peripheral; entrapment syndromes. The major entrapment syndromes are presented here with their symptomatic picture and muscle testing findings.

L – 5 nerve root – Iliolumbar ligament Syndrome

The fifth lumbar nerve root loops anterior after leaving the intervertebral foramina. It then traverses under the iliolumbar ligament and superior to the sacrum. The superior surface of the sacrum and the inferior surface of the iliolumbar ligament form a tunnel. Pecina, Krmpotic-Nemanic and Markiewitz term this the lumbosacral tunnel syndrome. After passing through this tunnel the fifth lumbar nerve joins the fourth lumbar nerve, which has traversed over the anterior surface of the ligament, to form the lumbosacral trunk. Peripheral nerves that are partially derived from the fifth lumbar nerve root include the superior and inferior gluteals, the sciatic, the common peroneal and the tibial nerves as well as the sacral plexus.



Entrapment of the nerve root is a result of alterations in the length of the iliolumbar ligament. Goodheart, based on the work of Illi, described a condition in which the iliolumbar ligament could effect the coordination of the body in a gait configuration. Basically, his test for involvement of the iliolumbar ligament was the failure of muscles to be properly inhibited in a gait position when the patient stepped backwards. In these cases, treatment was rendered as to shorten the ligament.

Localized injury to the iliolumbar ligament, usually from a rotational type force, can cause localized swelling that causes entrapment of the fifth lumbar nerve.

To test for this involvement, the patient may have to twist or lateral bend in a sitting position to create the entrapment. Conversely, rotation or lateral bending may relieve the entrapment causing a relief of symptoms and/or strengthening of any related structures. As the fifth lumbar nerve is part of the superior gluteal, inferior gluteal and sciatic nerves, almost any muscle of the lower extremity with the exception of the psoas, iliacus, quadriceps, sartorius and adductors can be used for testing.

An interesting observation is that if the ligament is shortened and needs to be elongated, the opposite gait inhibition pattern will be found. If the ligament is lengthened and needs to be shortened, the original Goodheart finding, the patient must step back in a gait pattern to disclose the failure to inhibit the gait muscles. If the ligament is shortened and needs to be lengthened, the patient will fail to show inhibition in the normal gait pattern.

Iliopsoas – Inguinal Ligament Syndrome

The femoral nerve and the femoral vascular structures accompany the iliopsoas as it passes beneath the inguinal ligament. The inguinal ligament attaches to the anterior superior iliac spine and extends down in an arc to its attachment on the pubic tubercle. It has a firm fascial connection to the fascia lata and the iliac fascia. An aponeurosis of the ligament forms a support for the spermatic cord. When viewed from an oblique angle, the inguinal ligament forms the superior margin of a tunnel like structure with the border on the innom-

inate forming the inferior margin of the tunnel. In this tunnel are the iliacus, the psoas, the femoral nerve, the iliopectineal fascia, the lumbo-inguinal nerve, the femoral artery and vein, the femoral ring and the lacunar ligament. The femoral ring may be of clinical importance because it is just anterior to this that the spermatic cord or the round ligament of the uterus is found.

The femoral nerve descends between the fibers of the psoas and the iliacus to exit inferior to the inguinal ligament. It supplies the iliacus superior to the inguinal ligament. The psoas is supplied by fibers from the second and third lumbar nerves. The first muscles innervated after the nerve clears the inguinal ligament are the pectineus and the sartorius. Inferior to this, the nerve supplies the entirety of the quadriceps muscle.

The physical signs of femoral nerve entrapment are obvious. The patient will have inhibition of the quadriceps muscle with strength of the iliacus. This condition should be suspected in any patient that has had localized trauma over the inguinal ligament, lower abdominal surgery or increased pain when the femur is extended. For example, when testing the gluteus maximus, the patient states that pain is increased in the groin area. The patient will have difficulty climbing stairs first and then arising from sitting. The quadriceps muscle will become atrophied.

Injuries, which can cause the iliacus or the psoas to enlarge or cause a shortening of the inguinal ligament, can cause entrapment of the femoral nerve. This is fairly easy to diagnose if you keep in mind that the iliacus is supplied above the ligament and the quadriceps below.

Ask the patient to perform a task that would use the iliopsoas.

Immediately test for inhibition of the rectus femoris or the vastus muscles. If inhibition is found, challenge the inguinal ligament for shortening by pressing on the ends of the ligament and pulling towards the attachments of the ligament. If this stops the inhibition pattern, continue to treat the ligament and balance all muscles that attach to the ligament.

An example of this condition was a patient who was a highly competitive runner on the international scene. She moved her household goods from one location to another and within two weeks of the move developed knee pains. She consulted numerous other practitioners about the leg pains which continued to worsen to the point where she could not run over 100 meters without leg pain. Prior treatment had included manipulation to the pelvis three times a week for six weeks, myofascial release techniques to the quadriceps, three sets of orthotics and four different anti-inflammatory medications.

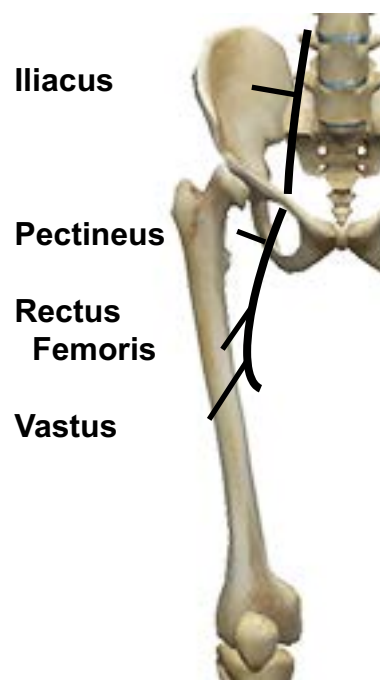
Examination revealed no signs of inhibition when the patient was first examined. She was placed on treadmill and her walking gait was observed. She exhibited excessive hip rotation on walking which indicated to me that she was not using her psoas to bring her femur anterior. Testing at this point still showed no inhibition pattern. The treadmill was increased in speed so that she could jog. After only one minute, the rectus femoris and the vastus muscles tested inhibited. Further testing revealed localized tenderness over the inguinal ligament and a positive testing for shortening of the ligament. Questioning revealed that she had rested heavy boxes against the ligament during the move that preceded the symptoms.

After correcting the ligament, she was instructed to perform the elongation of the ligament at home for the next week. Within ten days, she returned to training with no pain.

Obturator Syndrome

The obturator nerve is the motor supply to the adductor muscles. This nerve is composed of three sections from the second, third and fourth lumbar nerve roots. It descends along the medial posterior border of the psoas. Then it crosses the sacroiliac joint and then superior to the pubes traverses to enter the obturator foramen. The obturator tunnel is composed superiorly by the pubic bone and inferiorly by the internal and external obturator muscles. The tunnel holds the obturator artery and vein as well as the obturator nerve.

Femoral Nerve



This nerve entrapment syndrome is commonly found during pregnancy, localized trauma like horseback riding and lower abdominal surgery.

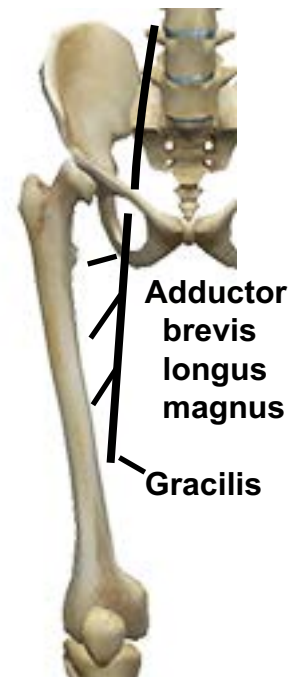
The symptoms can range from localized numbness to pain radiating down the medial aspect of the thigh to the medial aspect of the knee. The adductors will test inhibited and there may be visible atrophy of the muscle. The patient will begin to walk with the leg away from the midline with a noticeable lateral sway of the body.

It is this last finding that will help you to find this condition. If you suspect that the adductors are inhibited and you cannot find the inhibition, have the patient bear down as in the Valsalva test and test the adductors. The increased abdominal pressure may cause increased pressure on the obturator nerve as it exits the pelvis. This is common in cases of visceroptosis.

In general, the treatment consists of supporting the abdominal contents. Evaluation of the sacral base angle should be made and any alterations from normal stabilized. The integrity of the various sections of the abdominal muscles must be evaluated and corrected.

One of the uncommon causes of obturator neuropathy is pelvic cancer. Rogers and Borkowski reported, in the August 1993 issue of Neurology, on cases of pelvic cancer that had produced obturator nerve symptoms as the sole presenting symptom. Half of the patients had ipsilateral leg edema accompanying the nerve findings. The tumors included lymphoma, cancer of the bladder, pelvic papillary carcinoma and cancer of unknown origin.

Obturator Nerve



Piriformis Syndrome

The piriformis is a thick muscle that arises from the anterior surface of the sacrum by separate digitations that attach between the first, second, third and fourth anterior sacral foramina. Attachments are also possible at the sciatic foramen, the capsule of the sacroiliac joint and the sacrospinous ligament. The muscle attaches to the greater trochanter of the femur on its medial superior surface by means of a tendon that is joined by the tendons of the obturator internus and the gemelli muscles.

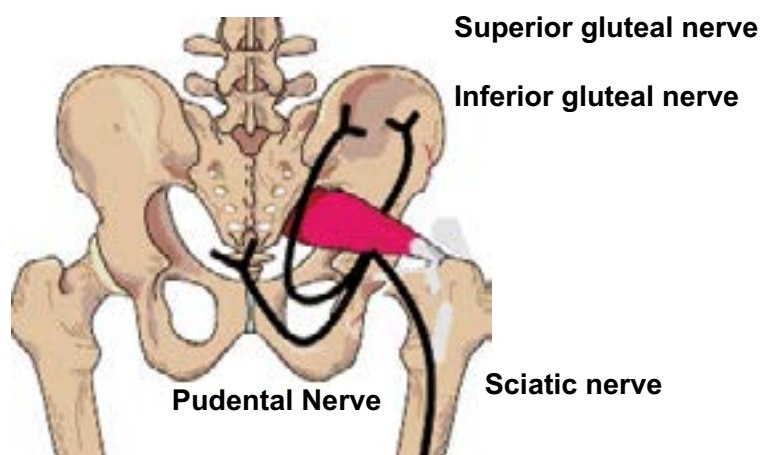
The greater sciatic foramen is bounded superiorly and anteriorly by the ilium. The posterior portion is formed by the sacrotuberous ligament and the inferior margin by the sacrospinous ligament.

Within this foramen pass nerves and blood vessels as well as the piriformis. Superiorly, the superior gluteal nerve and blood vessels pass between the ilium and the superior margin of the piriformis. The gluteal nerve supplies the gluteus medius, the gluteus minimus and the tensor fascia lata muscles. Inferior to the piriformis and adjacent to the greater sciatic foramen pass the sciatic nerve, the pudental nerve and blood vessels. Additional nerves which pass through the notch with the piriformis include the inferior gluteal, the posterior femoral cutaneous and those which supply the quadratus femoris, the obturator internus and the gemelli muscles. The inferior gluteal nerve is important in that it supplies the gluteus maximus muscle.

Any inhibition of the gluteus maximus causes over contraction of the piriformis creating entrapment of at least some of the structures discussed above.

If inhibition of any of the structures that are innervated by the nerves that pass through this area are found, either have the patient reduce the weight on the pelvis (if testing in a sitting position) or belt the pelvis using a

Piriformis Syndrome



trochanter type belt to approximate the sacroiliac joints. In either case, the related muscle inhibition patterns will strengthen.

One of the difficulties in diagnosing this condition is the fact that the piriformis changes its role as a rotator of the femur by 180 degrees when the femur is raised above 90 degrees. This presents problems when the patient is tested in a sitting position. If the patient leans forward, they can change the angle between the femur and the pelvis enough to cause the function of the piriformis in femur rotation by 180 degrees. This phenomenon is easily demonstrated by finding an inhibited piriformis with the femur flexed to 85 degrees. Raising the femur to 100 degrees flexion will result in a strong test. Reversing the test angle so that you are pressing on the lateral side of the lower leg and pressing the leg towards the midline will reveal the inhibited piriformis.

A common method to find this nerve entrapment is to adduct and flex the affected leg and then internally rotate the leg. This may apply pressure on the nerve from the piriformis. This same position can be used to aid in diagnosing the piriformis condition by testing for an inhibition of a strong muscle that is innervated below the piriformis while holding this leg position.

The major problem in correcting this condition is the relative strength of the gluteus maximus muscle. Inhibition of a muscle will result in chronic inhibition of the underlying ligaments. This combination of inhibited muscle and ligament laxity results in over contraction of another muscle attempting to stabilize the joint. This is a common finding throughout the body. Proper treatment requires correcting the muscle, correcting the ligament, correct manipulative procedures and possible bracing of the joint.

Popliteal Syndrome

In the posterior knee, the popliteus and the soleus muscles form an arch through which the popliteal artery and vein and the tibial nerve pass.

Due to the softness of the borders of the popliteal and soleus muscles, entrapment of the tibial nerve is rare. The major symptoms are of entrapment of the vascular structures.

Intermittent claudication following activity is the most common finding. The patient may complain of numbness, leg cramping or feelings of cold. Intermittent claudication may occur in well-conditioned athletes because of an unusual form of popliteal artery entrapment that results from over training. These patients complain of calf muscle cramping, rapid limb fatigue, and occasional paresthesia on the plantar surface of the foot when running on inclines or when repetitive jumping is performed.

Palpation of the dorsal pedis pulse may show variations of the pulse when the foot is plantar flexed or dorsiflexed. If nerve entrapment is suspected, test for inhibition of foot muscles with the foot forcefully plantar flexed and with the lower leg fully internally rotated contracting the popliteus muscle. The most important physical finding is local tenderness over the area of suspected entrapment.

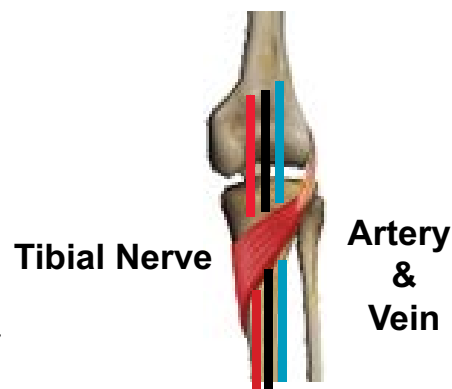
The history will usually reveal a hyperextension injury of the knee or a rotational type injury. The physical findings will reveal trigger points in the popliteus that will respond to either the strain counterstrain procedure or the spray and stretch technique.

Geissler, Corso and Caspari have reported, in the British Journal of Bone and Joint Surgery, that the popliteus can become ruptured and create a palsy of the tibial nerve. This was due to pressure on the neurovascular bundle in the proximal calf (5).

Peroneal Tunnel Syndrome

In the superior portion of the popliteal fossa, the common peroneal nerve is formed. The nerve then wraps around the head of the fibula and then descends to pass inferior to the attachment of the peroneus longus muscle. The nerve then passes through the peroneal tunnel at the level of the neck of the fibula.

Popliteal Syndrome



In cases of lateral deviation of the fibula caused by stretching of the ligaments that hold the head of the fibula against the tibia, the nerve becomes stretched.

The first muscles that will test inhibited are those innervated by the deep peroneal nerve, especially the peroneus tertius. As the condition worsens, all of the muscles supplied by the superficial and deep peroneal nerves will test inhibited. There will usually be palpable tenderness in the heads of the gastrocnemius. The inhibition and the tenderness will be relieved when the head of the fibula is approximated against the tibia.

This condition is more common than you would expect. Common findings unrelated to the peroneal nerve are increased tenderness in the gastrocnemius and possible inhibition in the lateral hamstrings.

You will see the failure of the peroneus muscles to control the foot in the walking pattern and the muscles will test extremely inhibited. If the patient is asked to approximate the fibular head, there will be an immediate lessening of the palpable pain in the gastrocnemius and a dramatic increase in strength of the peroneal muscles.

The fibular head must be treated in a similar fashion to the radial head in elbow problems. The joint must be approximated, the ligaments treated and the joint stabilized by a support.

It is common for this to take four to six weeks for the ligament to gain the strength to support the fibular head.

Care must be taken to examine the gait so that the person is not landing with a flat foot. Even though the fibula is supposedly a non-weight bearing bone, a common finding is to find that the patient is very heavy on their feet causing excessive jarring of the lower leg when they walk.

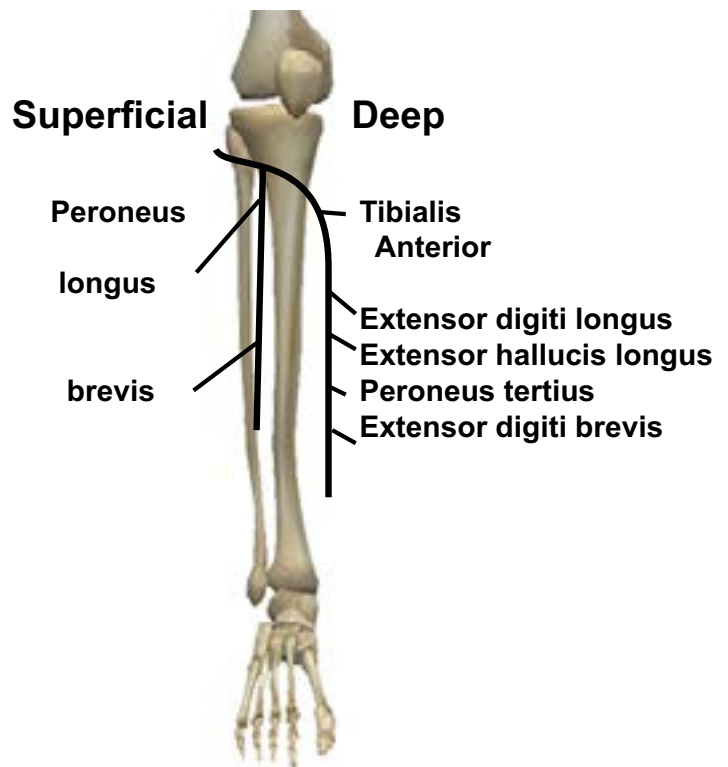
In extreme cases, a compression wrap around the lower leg has aided the healing. This is accomplished by using a three to four inch cloth wrap that the patient applies each morning before walking. It is worn throughout the day and removed only at bedtime.

This condition is commonly misdiagnosed as a lumbar disc problem. The symptoms include lower leg pain as well as muscular inhibition that make it appear like a chronic disc problem. In fact, one patient was scheduled for disc surgery and found to have this type of nerve entrapment.

The patient was a male nurse, approximately 71 inches in height and 375 pounds in weight. He had chronic leg problems and was scheduled for disc surgery to relieve the pain he had in his lower right leg. Examination revealed palpable pain in the gastrocnemius and inhibition of the foot muscles that increased in strength on approximation of the fibular head. It took eight weeks of taping and support and his symptoms have not returned in two years.

Another patient had fallen skiing and torqued the right knee. There was localized tenderness around the head of the fibula. She had been treated by a well-known orthopedist who specializes in knee problems and placed on crutches for three months. After being on the crutches, she began to trip over the smallest objects. Examination showed that she was not lifting her foot prior to heel strike. She had inhibition of the peroneal muscles that strengthened on approximation of the fibular head.

Peroneal Syndrome



Tarsal Tunnel Syndrome

The tarsal tunnel is found inferior and posterior to the medial malleolus. The lateral boundary of the tunnel is formed by the bones and the medial boundary by the flexor retinaculum. Through this tunnel pass the tibial nerve, the medial and lateral plantar nerves, the medial and lateral peroneal artery, the tibialis posterior, the flexor hallucis longus and flexor digitorum longus muscles.

The flexor hallucis brevis is the major muscle innervated after the tarsal tunnel. Entrapment of the structures in the tunnel will cause alterations in the vascular supply to the foot and inhibition of the flexor hallucis brevis. Chronic involvement leads to changes in the plantar muscles that will cause hammertoes - or a claw toe. While some consider this condition to be infrequently found, this condition will be found to accompany almost every case of bunion formation and chronic pronation.

This condition commonly is found when the navicular has dropped inferior. This causes the calcaneus to be moved in a posterior direction causing increased pressure on the flexor retinaculum. Other localized problems can produce a narrowing of the tunnel. These can result from chronic injury to the area, gouty formation of crystals, edema, etc.

A common finding is the patient who lands on their foot in a horizontal position and does not use the big toe to push off. This causes excessive stress on the ligaments and muscles of the foot that slowly causes the calcaneus to move in a posterior direction. In general, improper stride and mechanics of landing on the feet are common causes of this condition.

Correction requires supporting the arch of the foot, normal function of the tibialis posterior, manipulative procedures to normalize the position of the talus, navicular and the calcaneus and instruction on proper gait.

Anterior Tarsal Tunnel Syndrome

This syndrome occurs when the deep peroneal nerve is entrapped as it passes beneath the inferior extensor retinaculum. The floor of this tunnel is formed by the fascia overlying the talus and the navicular. Within the tunnel, beside the nerve, are four tendons, an artery and a vein. The retinaculum is a strong band and can easily cause excessive pressure on the deep peroneal nerve.

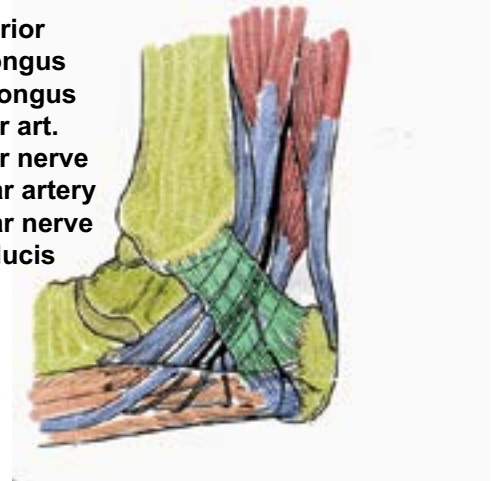
Anterior slippage of the talus is the initiating factor in this condition. This is common in people who wear elevated heels on their shoes or boots. Localized trauma should also be suspected.

The primary sensory symptom is one of pain between the first and second toes or a deep ache through the dorsum of the foot. The motor inhibition is most prominent in the extensor digitorum brevis muscle. The foot may have to be placed in full plantarflexion to find this inhibition pattern.

The most common finding will be an anterior displacement of the talus. This is easily corrected with proper manipulative techniques. After correction, the ligaments and skin overlying the talus should be challenged for involvement.

Tarsal Tunnel Syndrome

Tibialis posterior
Flexor hall. longus
Flexor digit. longus
Medial plantar art.
Medial plantar nerve
Lateral plantar artery
Lateral plantar nerve
Abductor hallucis



Anterior Tarsal Tunnel

Deep peroneal nerve

Superior and inferior extensor retinaculum

Extensor hallucis brevis



Examine the patient for their walking and/or running style, you will usually find a person who is landing on their toes. This excessive force will cause the talus to slip anterior. Instruct the patient on landing on their heels. This is of course impossible to do if the person wears heels over one inch in height.

Metatarsalgia

This term is used loosely to describe any discomfort around the metatarsal heads. The metatarsal tunnels lie between the superficial and deep transverse metatarsal ligaments. Within these tunnels lie the medial and lateral plantar nerves, arteries and veins. Chronic imbalances in the foot lead to over stretching of the transverse ligaments. This in time causes an increase in pressure over the middle three metatarsal heads. Causes of this condition vary from improper foot strike to shoes that are narrow compressing the metatarsal heads. A person, who consistently lands on the toes, or forefoot, will create this condition to the repetitive stress.

Entrapments of the nerves in these tunnels is known by many names. The most common name being Morton's neuroma. In general, entrapments are caused by misalignments of the metatarsals. Other causes include edema, fractures, inflammatory conditions, sesamoid bones, etc.

Pain can easily be palpated for over the dorsum of the foot. When this is found, place tongue depressors under the metatarsal arch elevating it. Repalpate the dorsum of the foot for a reduction of pain. There will also be inhibition of the extensor muscle of the great toe. This is easily tested with the patient standing. Have the person bring their weight forward over the front of the foot and test for inhibition of the toe extensors. This inhibition pattern will also be relieved if the metatarsal arch is elevated. In cases where the patient complains of pain when wearing shoes, grasp the foot and compress the metatarsals and palpate for pain.

Correction involves correcting all foot imbalances and elevating the metatarsal arch.

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Functional Muscle Testing

The previous sections of this book have covered the standard muscle testing that has been done for almost 80 years. One of the problems in a clinical setting is that these tests do not take into account the actions that muscles must perform during normal physical activities.



For example, the pectoral muscles are usually tested with the arm in a flexed position. However, many times injuries occur when the arm is extended such as reaching in the back of a car and pulling forward an object or in sports like throwing a discus where the arm is behind you and forces are applied to bring the arm forward. In cases like this, muscles need to be tested at these varying positions in order to uncover hidden inhibition patterns that would usually be missed in the standard muscle testing positions.



Another example is testing for nerve entrapment. In these situations, the extremity needs to be placed in specific positions which cause stretching on the nerves or aggravates possible entrapments in order to uncover the problem. Consequently, I called this functional muscle testing.

In this short chapter, examples of this will be discussed in the foot and in the arm.

Testing of the extensor and flexor muscles especially of the great toe in a neutral position can uncover dramatic inhibition however it fails to find functional inhibition patterns of the muscle that occur in normal walking, running or jumping.



In normal walking, you push off with the toes. This is even more evident in runners, jumpers as in volleyball or basketball and in sports like tennis. In these conditions, the foot is in dorsiflexion and the flexor muscles of the toes especially the flexor hallucis longus and brevis need to contract to push the body forward. In jumping, the foot is in full plantarflexion when the contraction of these muscles occurs. To adequately test normal functioning of the flexor hallucis brevis and longus the foot must be placed in both full plantarflexion and dorsiflexion. Each of these positions can cause and will show inhibition patterns that are normally overlooked. In plantarflexion contraction of the gastrocnemius and soleus will apply pressure to the calcaneus and potentially cause entrapment of the nerve or tendon.



In the upper extremity testing for proper function of the opponens pollicis and opponens digiti minimi with the hand in a neutral position will uncover severe patterns of nerve entrapment at the wrist.

However, placing the wrist into extension potentially increases pressure on the median or ulnar nerves resulting in abnormal inhibition of these muscles.





However, as described in the previous chapter on upper extremity nerve entrapment, you can isolate and find potential problems by placing the wrist not only in extension but the forearm in full pronation, extending the arm behind you causing contraction of the pectoralis minor, turning the head to contract the anterior scalene and then flexing the head causing stress of the cervical spine places strain on the length of the nerves. This results in extreme tension placed on the nerves from the cervical spine through the hand. This allows you to find hidden nerve entrapments that are many times missed.

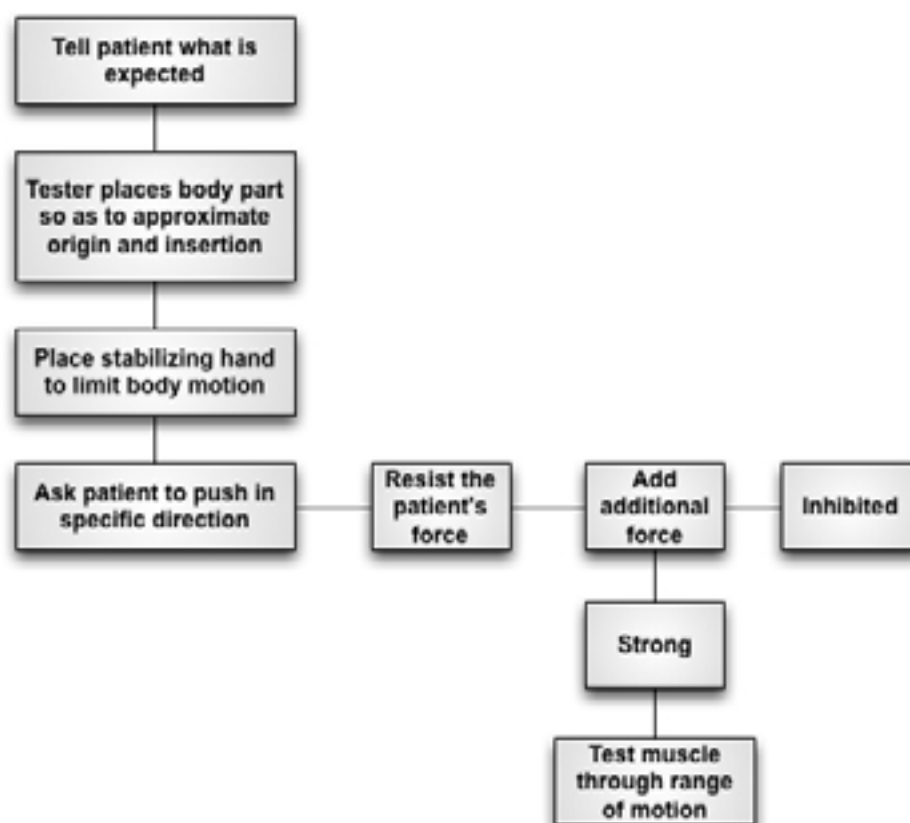


One final example in the leg are the functions of the gluteus maximus and hamstrings. In normal walking, the hamstrings and gluteus maximus contract to slow down the forward movement of the leg. Testing in the normal neutral position of the femur may not uncover inefficient patterns that occur when the leg is in flexion. Testing of the femur in 15 to 30° of flexion as the leg would be in normal walking and running will many times uncover inhibition patterns that are so often missed.

Examples of functional muscle testing will be discussed in future texts on these subjects.

The first goal is to get to learn how to test muscles properly in the standard positions that have been taught for years. Then depending upon your practice and the patient base that you have, you need to start thinking about how the muscles function and work in real life. Then you can adapt your testing in situations when patients say they have problems or symptoms returning when they do certain activities.

There is a science to muscle testing but it is also an art that must be learned and practiced.



Common Problems in Muscle Testing

Stabilization of the patient is essential. At times, the table or chair will supply all the force that is needed. However, this is not common. You will usually have to provide pressure with your hand. Placement of the hand is critical. Try and place your hand on a soft part of the body if at all possible. Here the hand is placed on the upper thigh. If you set the stabilizing hand on the pelvis over the anterior iliac spine, you can create pain or at least discomfort to the patient during the test causing inappropriate inhibition of the muscle. This contact may also be uncomfortable for many patients being close to their groin.



The testing hand can be a significant problem in proper muscle testing. The fleshy parts of the hand are the best used.

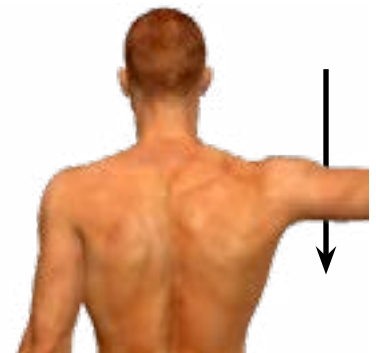


For example, testing with the fingers against a bone will almost always cause inappropriate inhibition. The same is with testing using the side of your hand. Pulling of the skin can also inhibit.



The vector of force used by the testing person is fundamental. In the text of this book, it says apply force at a tangent to the arc of the body part being tested.

In testing the deltoid, the force needs to be at 90 degrees to the position of the elbow.



If the force is applied at an angle towards the body, this may compress the joint and cause abnormal inhibition of the muscle.

Likewise, applying pressure at an angle away from the body reduces the stress on the muscle, and you do not find an inhibited muscle that actually exists.



Care must be taken to make sure the person does not move a body part distal to the muscle being tested. This action can cause facilitation of an inhibited muscle. For example, if you are testing the long head of the biceps flexing the wrist or the fingers can facilitate the muscle. In the leg, dorsiflexion of the foot can facilitate the quadriceps or the psoas. Plantar flexion of the foot can cause facilitation of the gluteus maximus

Another mistake is to make sure the tested person does not take a deep breath and hold it. Respiration may affect muscle strength.

Keep the rest of the person's body in a constant position. For example, if you are testing a hand muscle and the person looks down changing the alignment of the cervical spine, it might create a nerve entrapment causing inhibition.



Variations on Muscle Testing

In general, muscle testing is done with the person lying on a table or sitting. The muscle is tested in a standard position. This is the standardized muscle test as presented in all books and presentations.

However, depending on the person and what they do, the testing position may need to be altered to uncover problems.

A computer programmer presented with numbness in both hands that occurred 2 hours at work. His company sent him for a neurologic examination, and an EMG was performed. He was told there was no problem. When asked how he sat while working, he sat in a very slouched position. Testing showed dramatic inhibition of the hand muscles as well as the forearm extensors that were not present when he sat up with good posture or tested in a supine position.

Many questions need to be asked before testing begins. These include items like what are you doing when you have problems, what is your occupation, what position do you sleep in and many more like this. These need to be taken into mind when you decide how to test the person.

If a muscle has a long origin or insertion, the muscle may need to be tested in varying angles to isolate portions of the muscle. The gluteus medius or the pectoralis muscles are good examples of this.

In general, use the standard muscle testing positions. If you do not find a problem, then vary the test using their work or positions when they have symptoms.

Muscle Therapies

The following pages will describe the most common muscle therapies that are necessary in the treatment of common injuries.

Most of these were developed by others. For many, the treatment decisions are based on palpation or differences in range of motion.

Dr. Goodheart developed muscle testing procedures to determine which ones were indicated, when to employ them and to determine that they were successful.

It is the integration of the different therapies that leads to best results.

There are other muscle procedures that have been developed and they will be described in future books in this series.

The goal here is to give you, the reader, some basic tools that can be used to help normalize Both muscle action but muscle coordination.

Introduction

In sports, muscle injuries are the most common complaint. Some statistics show that these type of injuries range from 10 to 55% of all reported injuries and is most athletes will not talk about things when they partially injure themselves the statistics are probably underreported.

In sports, the most common muscles that are injured are the hamstrings, adductors, quadriceps and the lower leg muscles.

There are two types of injuries that muscles sustain. The first is a shearing type caused by contusions or strains. Here the muscle fibers and their basal lamina, myofibrils as well as the capillaries all become injured or ruptured. In the other type of injury, the muscle fibers become partially injured and necrotic. While the basal lamina and myofibrils and the related blood vessels remain intact. Injuries to the muscles occur when they're subjected to sudden compressive forces such as a direct blow this is the case the contusions. In the strains, the muscle fibers are exposed to excessive forces.

Minor strains in sports to the muscles result in a condition called delayed onset muscle soreness or DOMS.

You can grade muscle strains as being mild where only a few of the muscle fibers are damaged and there is minor swelling and discomfort, and there is usually a minimal loss of strength and some restriction in motion. Obviously, in moderate strains, there is more significant damage to the muscle itself in a dramatic decrease in power. Severe muscle strains occur when there is a tearing of the with a complete loss of strength and ability of the muscle to contract.

It is the first type of mild and moderate strains that are appropriate for the origin insertion technique that Dr. Goodheart first found back in the 1960s. In these type of injuries, the area of involvement is usually close to the muscle tendon junction. It is close to the tendon but found closer to the muscle fibers as they taper towards the tendon.

The healing of muscle strains occurs in three phases. There is a destructive phase where the area is walled off by contraction and the creation a sealed area by the creation of a sarcolemma. The injured muscle fibers contract and the space between them is filled with a hematoma. Inflammation now occurs. In the repair phase, phagocytosis occurs, and the ongoing repair of the muscle fibers starts to happen. This usually begins within 24 hours after the injury. Depending upon the extent of the damage, this can take a few days. Often, within one week the muscle fibers are being repaired, and the new fibers begin to penetrate into the fibrotic tissue that has occurred between the injured muscle fibers. New capillaries now begin to form, and this action begins approximately three days after the injury.

The final stage, remodeling, continues and depending on the injury this can take weeks or months. If proper care or rest is not given, this stage never comes to completion with normalization of the tissue.

Origin-Insertion Technique

This is the original technique found to strengthen an inhibited by George Goodheart. According to Dr. Goodheart, he was examining a patient who had an unstable shoulder and tested the serratus anterior which was extremely inhibited. He palpated the origin of the muscle on the superior margin of the ribs laterally and found multiple small areas of tenderness. He massaged these out and found out that immediately afterward the muscle increased its strength dramatically. The increase in strength was approximately 70% of the opposite extremity. This surprised him because this was the first time that he was able to substantially change the relative strength of a muscle by doing a simple procedure. This became the birth of what became known as applied kinesiology.



He then began to explore muscle inhibition patterns that he found in other patients and spent the next year traveling and lecturing showing other doctors how to test muscles and to look for patterns like this.

The type of massage that was used was of a rotary firm pressure. Currently, instead of using hard hand pressure a percussion type instrument can be used instead.

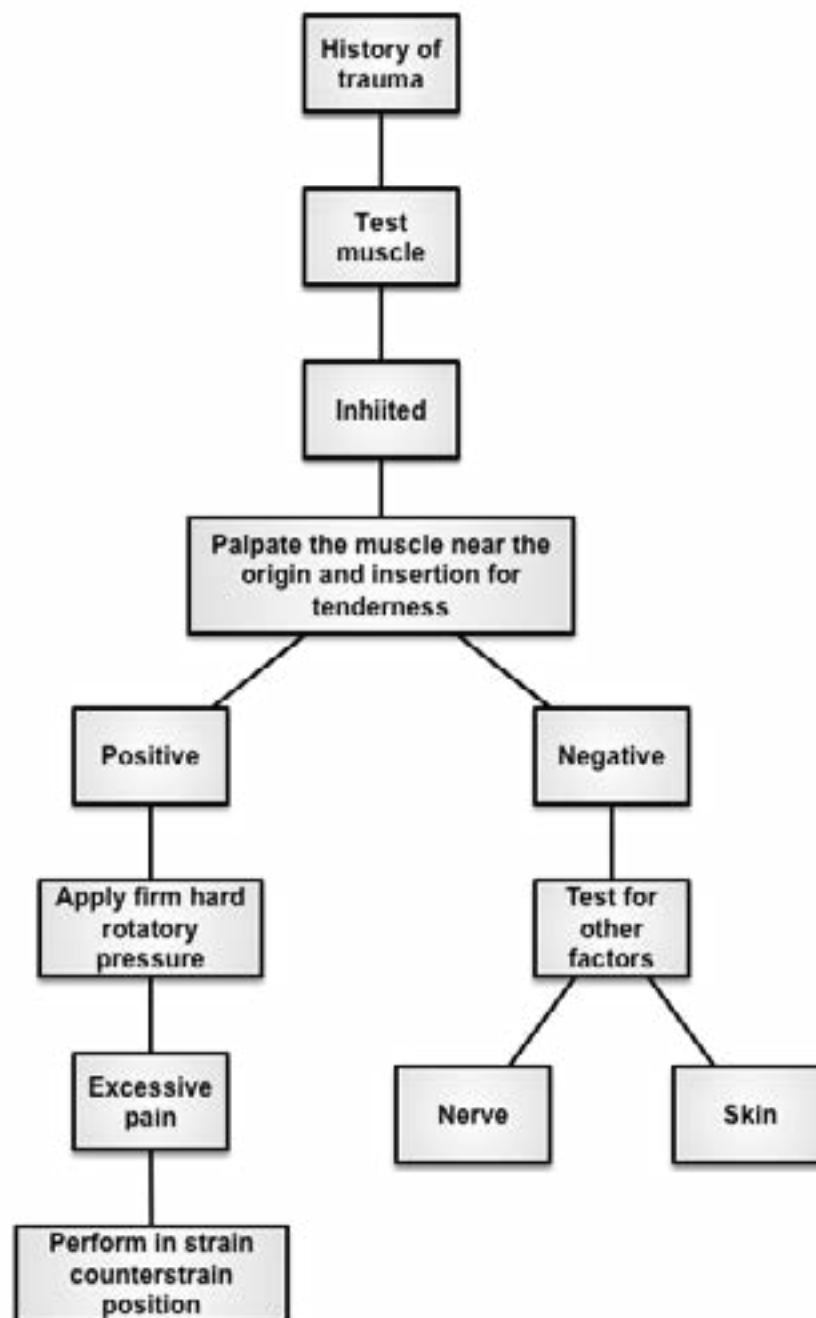
This technique is slightly painful to the patient but placing the extremity or body part approximating the origin and insertion will dramatically reduce the discomfort.

Goodheart's original theory of why this worked was based on work done at Duke University on injuries sustained in their athletic department. He would quote that their findings showed that micro muscle injuries were the most common type of sports injury.

Micro-avulsion of the tendon at its junction with the muscle fibers will cause the muscle to become inhibited.

Hard, heavy pressure is applied at the tender involved area of the inhibited muscle for 30-60 seconds. The muscle should then test normally if a micro-avulsion existed.

This technique is indicated in any traumatic or over use injury.



Muscle Proprioceptors

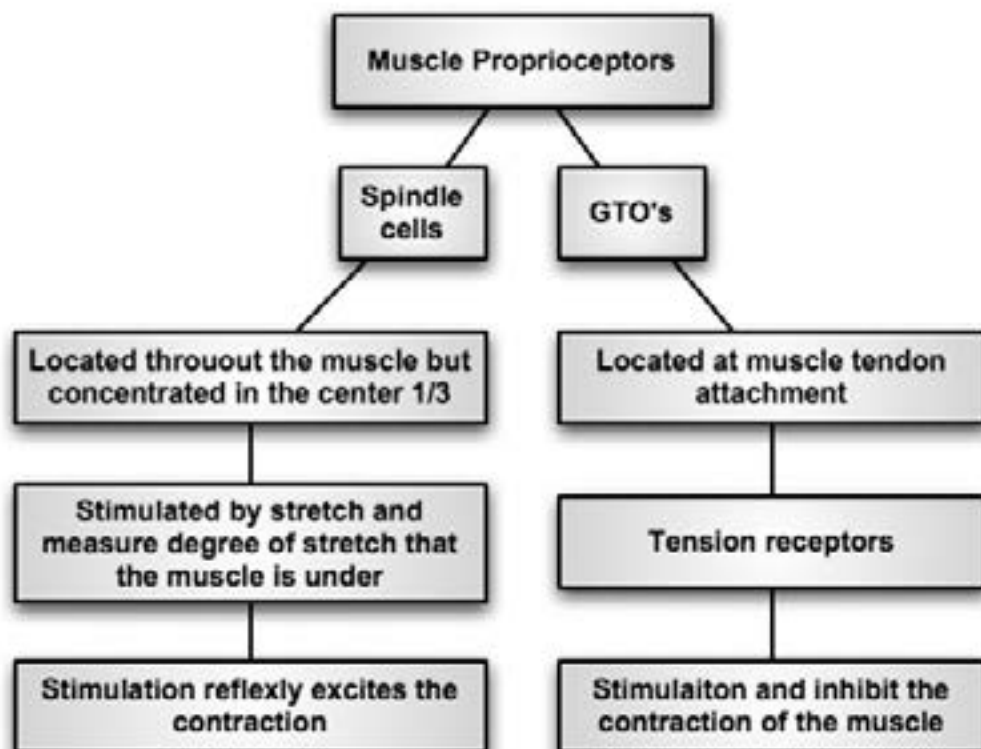
Spindle cells are found in nearly all muscles and are more numerous in the muscles of the limbs than those of the trunk. They are located throughout the muscle, but are more concentrated in the center portion of the muscle. Because the long axis of the spindle is parallel with the long axis of the muscle, it is stimulated by stretch. This results in nerve impulses in the afferent nerve fibers. These specialized cells are responsible for informing the brain on the degree of stretch that the muscle is under.

The proprioceptive spindle cells vary in length from 2 to 20 mm and enclosed in a sheath which creates a fluid-filled cavity. In this cavity, there are 3 to 10 small muscle fibers that are called intrafusal fibers. These fibers are short and do not contribute to the strength of the muscle. They are attached to fibers that are called extrafusal fibers. The intrafusal fibers are either stretched or shortened along with the extrafusal fibers. The spindle cells act to compare the lengths of the intrafusal and extrafusal fibers through the efferent and afferent nerve supply to the intrafusal fibers. Spindle cell afferents exert an effect which causes facilitation of synergistic muscles and inhibition on antagonistic muscles.

When the spindle cells are involved, the area around them will be tender to palpation.

Treating spindle cells is somewhat dependent upon the size and location of the muscle. Small muscles require as little as 2 pounds of pressure or 1 kg and large muscles like the quadriceps may require up to 7 kg or 16 pounds of pressure.

Pressure, applied as to approximate together the fibers of the muscle in its linear length, has the effect of relaxing or inhibiting the muscle. Pressure, applied as to stretch the muscle fibers, has the effect of increasing the strength of a muscle.

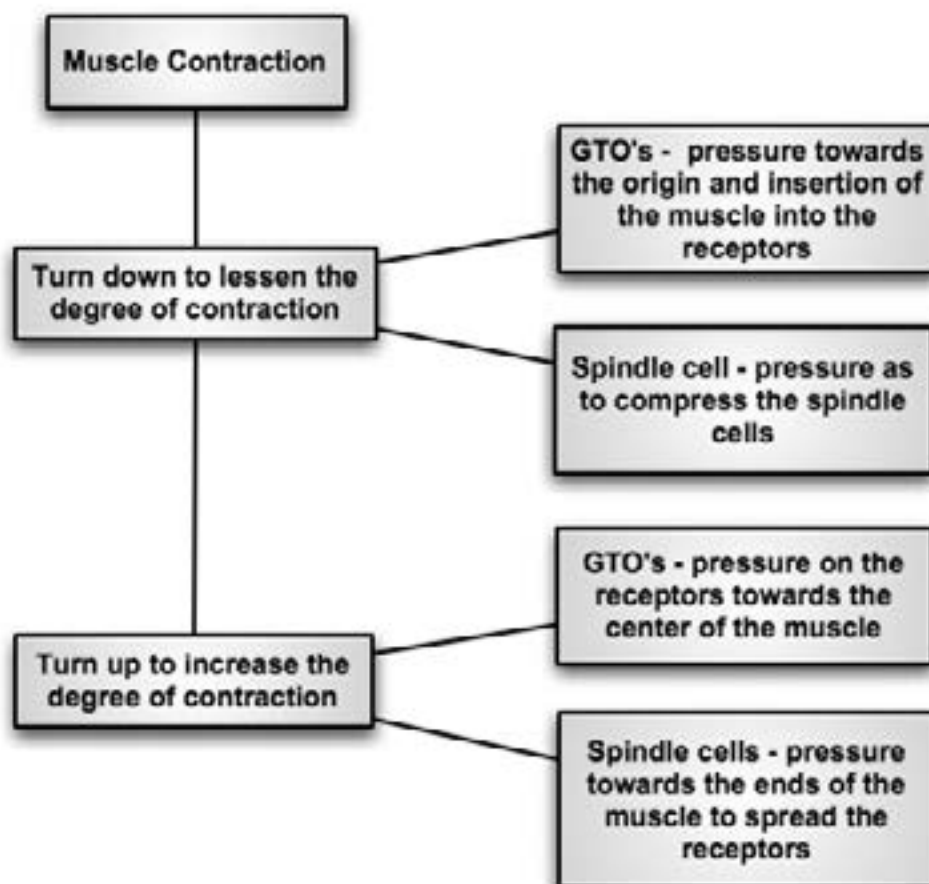


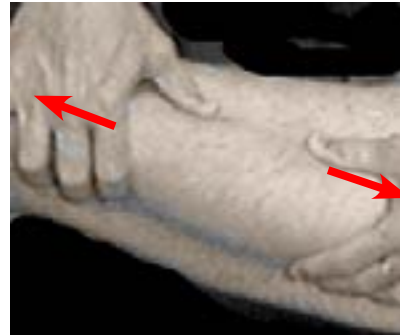
Golgi tendons organs are located in the tendon of a muscle at the muscle-tendon junction. Muscle fibers are attached to each Golgi tendon organ.

Most tendons are supplied with stretch receptors (Golgi tendon organs) which are located near the attachment of the muscle and the tendon. Tension on the tendon distorts these receptors stimulating them. Stimulation of stretch receptors in a muscle reflexly excites contraction of the muscle while stimulation of stretch receptors in the tendon inhibits the contraction of the muscle.

Pressure applied against the tendon towards the origin or the insertion of the muscle has the effect of inhibiting the function of the muscle. Pressure applied against the tendon in a direction towards the belly of the muscle, as if to lengthen the tendon, has the effect of strengthening or increasing the force of contraction of the muscle.

Where the pressure that is needed to treat spindle cells varies by the muscle being treated, the Golgi tendon organs requires a more firm heavy pressure. The spindle cells measure and monitor the length of muscle fibers while the Golgi tendon organ monitors the tension on the tendon.





To turn down and weaken a muscle press the spindle cells together and push towards the origin and insertion at the tendons.



To turn up and strengthen a muscle pull the spindle cells apart and push towards the belly of the muscle at the tendons.

Fascial Technique

Fascia are sheets of avascular, transparent, elastic connective tissue covering and encasing each muscle and visceral organ.

By connecting together, fascial tissues subdivide the body into functional units.

Travell spent years researching “trigger points” and referred pain patterns. The trigger points are almost always near the belly of the muscle. These have been diagrammed in the muscle section of this book. Trigger points are found in non-symptomatic patients.

The myofascial trigger point is found in a taut small area within the muscle fibers and is painful when pressed. Not all trigger points will cause the referred pain patterns that Travell describes and are diagrammed in the first part of this book.

To test for these areas, the flat of the fingers are gently moved along the line of the muscle fibers. If the skin is loose, one hand pulls the skin to tighten it. The palpation is looking for a band that feels like a small rope or a circular area of tightness that is tender.

Typically, the fascia and underlying muscle should be the same length. This allows the two to function as an integral unit.

If the fascia shortens in relationship to the potential length of the muscle, it creates a neurological imbalance in the control of the muscular contraction. Travell documented the existence of trigger points within the involved muscle that can cause referred pain patterns. However, this is not always the case. You will find involvement of the fascia many times without the referred pain pattern,

Another problem is that small adhesions or cross-links can occur that limit the flexibility of the fascia and the muscle.

If a trigger point is found in a muscle, stretch the muscle gently and repalpate for a reduction in the tenderness of the trigger point. This is an indication that the muscle's fascia needs treatment. If this causes an increase in the referred pain pattern, a Travell trigger point is present.

Goodheart developed a test for fascial problems that involved stretching the muscle.

Stretch the muscle to its normal limit of motion. If the muscle is a weight-bearing muscle, this is done slowly. Non-weight bearing muscles are tested by stretching the fibers quickly.

After stretching, the muscle is quickly retested for inhibition. If found, an involvement of the fascia is diagnosed.

Leaf has found that applying pressure at 90 degrees to the line of the muscle fibers will result in inhibition if there is any restriction due to adhesions or cross links. These are protein bonds that occur as part of the healing process. This technique is excellent when the mobility of the body part is severely restricted.

Goodheart advocated utilizing a hard, heavy pressure, to “iron out” the fascia using pressure in the line of the underlying muscle fibers. Massage from either the origin towards the insertion or from the insertion towards the origin.

Travell used a technique of using a vapocoolant spray over the stretched muscle for only a few seconds followed by warming and then stretching. The spray is angled at 30 - 40 degrees and applied along the line of the muscle fibers over the stretched muscle. It should be followed by moist heat and moving the body part through a normal range of motion or at least what the part can be moved without pain.

Percussion can also be used over the stretched muscle. Another procedure is termed pin and stretch. Here the muscle is shortened, and pressure is applied to the muscle while it is stretched. This is repeated 3 - 5 times along the muscle length of the muscle while repeating the shortening and elongation.

The patient can be shown how to do this at home using an ice cube and a hot moist towel.

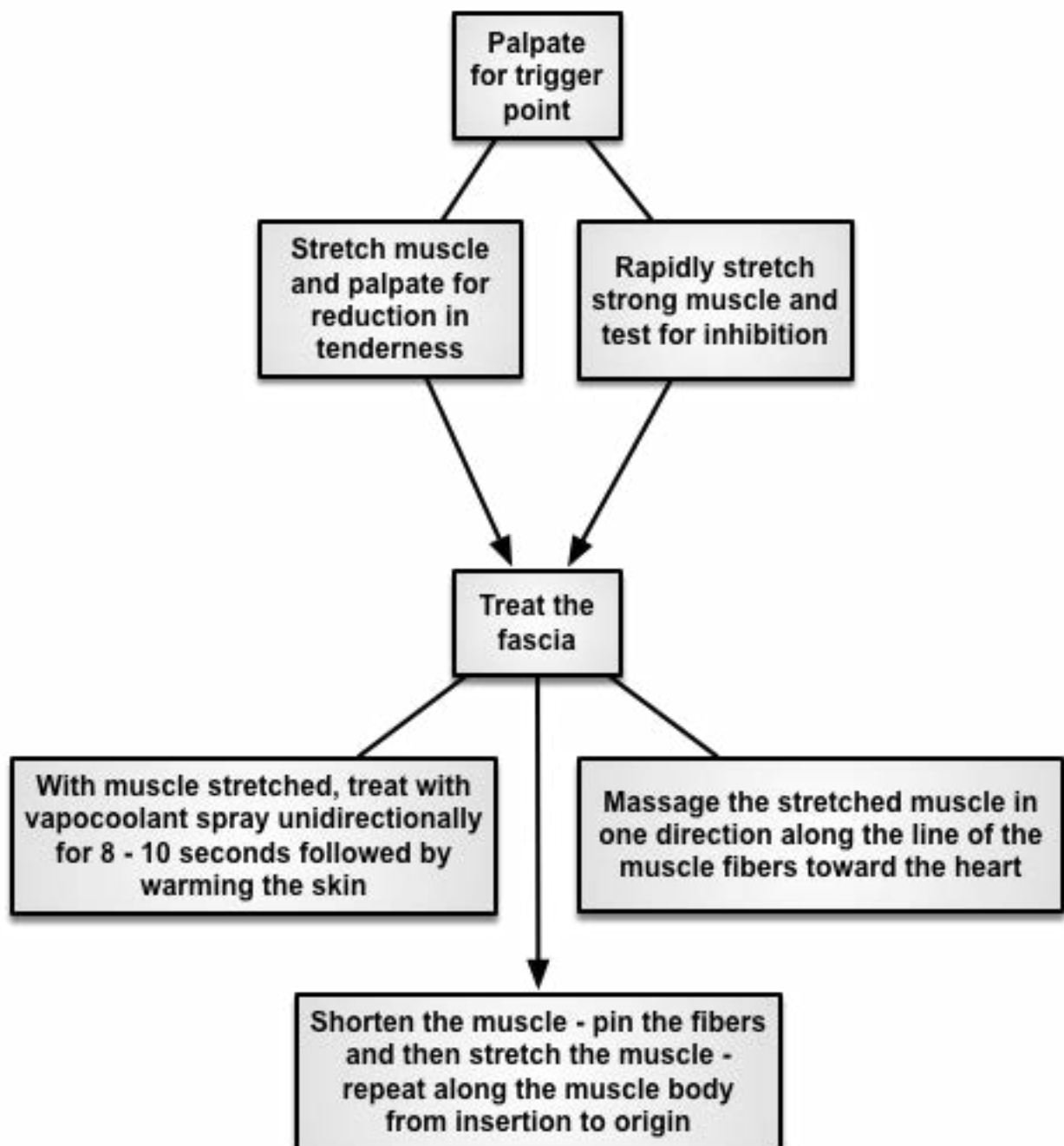
Stretch Test

The example is for the peroneus longus.

The picture above on the left shows the beginning position for the peroneus longus test.

The picture on the right shows the stretched position. This is done quickly and the peroneus is tested quickly .

If you wait too long, 2 - 3 seconds, it invalidates the stretch response.



Pin and Stretch Example



Shorten the muscle and apply pressure. You, or the patient will do this progressively up the muscle.



Begin to stretch the muscle while holding constant pressure against the muscle.



Stretch the muscle until a restriction or tenderness is felt.

Repeat the procedure along the length of the muscle and do this for 2 - 3 repetitions.

Massage or Percussion

The muscle is stretched and held in the stretched position.



One option is to massage upwards along the muscle fibers having put hand lotion on the skin.



The other option is to use a machine to percuss upwards along the line of the stretched muscle fibers.



Cross-links between the medial and lateral hamstrings

Test the individual groups and then apply pressure at 90 degrees pushing the biceps femoris laterally away from the medial hamstring group. If inhibition occurs, suspect adhesions between the two.

Option 1

Apply pressure against the muscle while moving the lower leg from a bent flexed position to a straight position.

This is repeated along the length of the muscle. Testing can be done to find the areas of involvement by testing with the 90 degree pressure.



Option 2

Place a percussion machine between the lateral and medial hamstrings and have the patient extend and flex the knee while force is given to slow the motion of the extremity. The force slowing down the motion of the lower leg should be gentle.



Strain Counter-Strain

This condition will create areas of pain similar to those described by Travell in her books and articles on myofascial pain. The major difference between the two lies in the type of treatment needed to alleviate the pain pattern. Jones' procedure is based on trial and error to determine if his procedure of postural positioning is indicated. Goodheart has devised a system for evaluating the muscles to determine if Jones' procedure of static positioning is indicated.

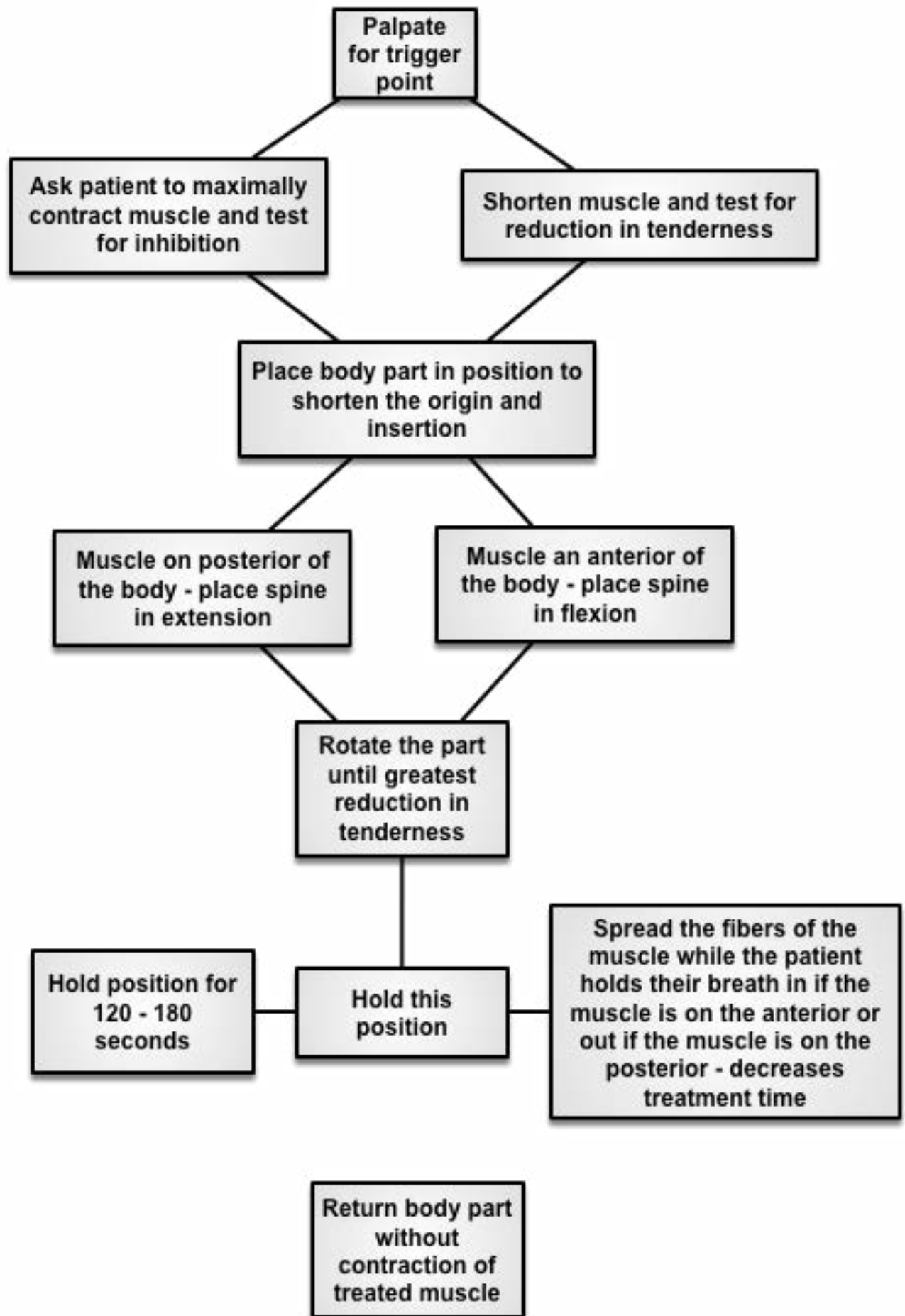
1. Palpation must locate the area of trigger point tenderness.
2. Check for fascial involvement by stretching the muscle that is associated with the region found and corrects any imbalances.
3. Check for fascial involvement by stretching the muscle and retesting for inhibition. If inhibition is found, treat accordingly.
4. Fully contract the muscle by having the patient approximate the origin and the insertion as far as possible, and retest the muscle for inhibition. Inhibition found after this procedure indicates a need for the strain - counterstrain technique.

Strain - Counterstrain Procedure

1. While palpating the tender trigger point, the parts of the body where the trigger point is located will be positioned so that the highest reduction in tenderness is achieved. As a general rule, if the trigger point is on the front of the body, the body part will be placed into flexion. If the trigger point is on the posterior aspect of the body, extension will be employed. The farther from the midline that the trigger point is, the more rotation that will need to be used.
2. Using Jones' procedure, this position is held for up to 180 seconds for the alleviation of the trigger point pain. Goodheart suggests that while the position is being held, a stretching of the spindle cells in the belly of the muscles be done. This will decrease the length of time that the position must be maintained.

This is an example of the position to treat the gastrocnemius





Palpate and find the tender point in the muscle. Here the levator scapula



Extend and rotate the neck shortening the muscle to find the greatest reduction in tenderness.



Step 1

Resist the maximal contraction of the muscle for 2 - 3 seconds and test for inhibition immediately after the resisted contraction



Step 3

Shorten the muscle finding the position that reduces the palpable tenderness the most.



Step 2

Palpate for the area of tenderness within the muscle



Step 4

Either hold this position for 12 - 180 seconds, or press together in the belly of the muscle which shortens the treatment time.

Aerobic / Anaerobic Muscle Testing

The 3 types of skeletal muscle fibers are:

Red / Slow (Type I fibers, 'slow twitch fibers')

Red / Fast (Type IIa fibers, 'fast oxidative fibers')

White / Fast (Type IIx fibers, 'fast glycolytic fibers')

White / Fast (Type IIb fibers, 'very fast glycolytic fibers')

Aerobic Muscles

The aerobic muscle fibers are known as type I. They are classically red in color and are also known as slow twitch fibers as they take three times longer to contract after stimulation than the fast firing fibers. Small diameter slow conducting motor neurons activate them. Muscles which contain a majority of slow twitch fibers have a more significant vascular support than do the fast twitch muscles. They are higher in myoglobin, like hemoglobin, it has iron. These muscle fibers contain more significant numbers of mitochondria and depend upon cellular respiration for ATP production. These are the muscles of the legs and the muscles of posture, and they are resistant to fatigue.

These are slow-firing muscles, the dark meat of a turkey. They exhibit high elasticity and high endurance. Oxidative metabolism of fats fuels them. Myoglobin holds the oxygen in the muscle for the oxidative process. The myoglobin in the muscles has a higher affinity for oxygen than hemoglobin.

Anaerobic Muscles

These are fast-firing muscles and there are three subdivisions of the Type II fiber group. The differences between the three is in their resistance to fatigue when used. The speed difference between the slow twitch fibers and the fast twitch fibers is that the fast twitch fibers fire four times or more faster than the slow twitch fibers.

In anaerobic activity, the muscle fibers first use ATP that is stored in the muscles. This is for the first five seconds or so. After that ATP is formed from creatine phosphate and ADP. After about 30 seconds to a minute, glycogen stored in the muscles is broken down into glucose which is oxidized to generate ATP. The very fast Type IIb fibers have already fatigued at this point.

Aerobic muscle test

For aerobic muscle fibers, the muscles of support, retest a functioning muscle in a rhythmic, slow, repetitive manner. Do this testing at least twenty times. The testing should be at a rate of one test every 1 - 1.5 seconds.

If this pattern is found in multiple muscles on both upper and lower extremity testing, there maybe insufficient iron to support myoglobin levels.

Anaerobic muscle test

For anaerobic muscle fibers, the fast-firing muscles of the upper extremity, retest in quick, rapid succession at least twenty times. Here, the testing is done faster than one test a second.

If this pattern is found in multiple muscles on both upper and lower extremity testing, there maybe insufficient

cofactors, B complex, for the breakdown of glycogen in the Krebs cycle.

While the major muscle groups are comprised of a majority of one or two types of muscle fibers, there are both slow and fast twitch fibers in human muscles. It is just the t change.

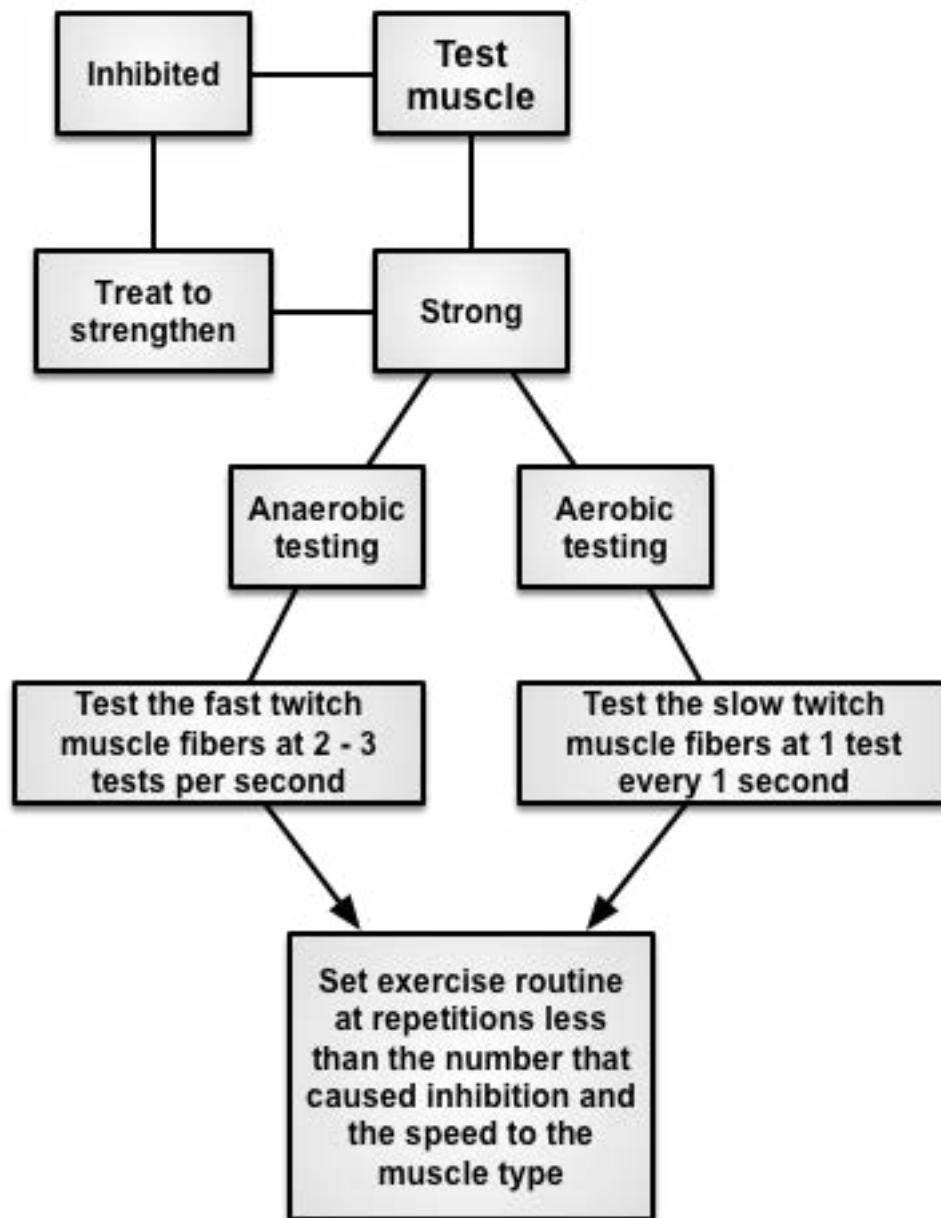
Consequently, depending on the sport or activity of the person, you may need to test for both types of fibers in an individual muscle.

The use of these tests is excellent to help to determine the maximum number of repetitions that should be used when rehabilitating a muscle. For example, if testing the quadriceps for slow twitch function and it becomes inhibited on the fifth muscle test, then exercising doing sets of four would be appropriate with a 4 second time between sets.

Testing should be done weekly to determine the improvement from the exercise program.

Characteristics of Muscle Fibers

	Type I	Type IIa	Type II x	Type IIb
Contraction time	Slow	Mod. fast	Fast	Very fast
Resistance to fatigue	High	High	Moderate	Low
Activity use	Aerobic	Long term anaerobic	Short term anaerobic	Short tem anaerobic
Maximum use time	Hours	Less than 30 minutes	Less than 5 minutes	Less than 1 minute
Power	Low	Medium	High	Very high
Mitochondrial density	Very High	High	Medium	Low
Oxidative capacity	High	High	Moderate	Low
Fuel source	Triglycerides	Creatine ph. glycogen	ATP, creatine phosphate	ATP creatine phosphate
Miscellaneous	Consumes lactic acid	Produces lactic acid		



Muscle Coordination Introduction

Proprioceptive neuromuscular facilitation otherwise known as P and F was started and originated with the work of Dr. Herman Kabot who described himself as a clinical neural physiologist. In the 1940s he became aware of the work of Sr. Elizabeth Kenny who was working with polio victims. He examined her work and found that some of it made physiological sense and some did not.

Cabot took this work and slowly developed it during the 1950s until he found a combination of resisted motions in the body that made sense to him. He primarily used maximum resistance and stretch to cause a facilitation response in weak muscles. He mainly was working in stimulating proximal muscles to stimulate distal muscles to contract. He then added in work from Sherrington in neurophysiology using his principles of successive induction, reciprocal innervation, and inhibition. This was the beginning of the advancements of PNF.

To sum up this technique it involves mass movement patterns of muscles in ordinary neuromuscular actions. PNF requires shortening and lengthening of muscles through motions that are commonly used in sports and physical activity. In most of the extremities, it involves diagonal movement along with rotation.

It is seldom that an extremity is moved in strictly flexion or extension, but there is a degree of rotation that occurs. When you're walking, and you bring your leg forward, there is a certain amount of rotation that happens in the femur and in the lower leg from the extreme of extension to the normal flexion of the arm leg and walking. It is easier to think of this as a chain reaction of muscles that work together to coordinate muscle activity. There are prime movers in their other synergistic muscles that are involved in during this action there is always an inhibition of the antagonist muscles.

When considering the motion of a body part there is a major motion, and that is the prime mover in their other secondary motions that occur that augment this action. Usually, the secondary motions involve either abduction or adduction and internal or external rotation.

For example, in walking the source is a major muscle that flexes the femur and brings it forward but as the leg is brought forward, there is also abduction and internal rotation that take place. The sartorius could be considered the primary muscle of action. However, the psoas is not the only muscle that acts in this motion. The psoas minor as well as the iliacus are also involved in this, and together this is called the iliopsoas group. However, as the leg is brought forward other muscles are affected by this pattern. They include the gracilis, the sartorius, the adductors, the rectus femoris as well as the obturator externus. It is the coordinated action of all of these muscles together that bring the femur forward. It is the also coordination of these muscles, not just their normal strength, that has to be considered.

Just as the above muscles work in a coordinated fashion, there is an antagonistic pattern of a chain of muscles that now becomes inhibited by the action of the flexion of the leg.

An excellent example of this is in the foot. When the leg comes forward, the extensor muscles especially of the great toe contract along with tibialis anterior, and the foot is dorsiflexed assisted by peroneus tertius. As the leg is brought forward, the gastrocnemius, soleus, tibialis posterior, peroneus longus, and brevis, as well as the toe flexors, are inhibited.

Coordinated muscle function has to occur in many ways. An example of this is rising from a sitting position and then sitting back down. When you first start to stand up the initial muscle action is to pressure the foot into the floor followed by contraction of the quadriceps gluteus maximus elevating you up. In lowering to sit down, there is an eccentric contraction allowing you to slowly lower yourself to the seat all of this functions in a coordinated manner

An article by Nicholas in the American Journal of sports medicine in 1980 entitled the neurophysiological inhibition of strength following tactile stimulation of the skin showed that scratching the skin over in antagonistic

muscle will cause an inhibition of the act agonist as it is tested for strength. This is a short quick response that occurs

When a muscle is stretched, the standard physiological response is that the muscle will respond with greater force when tested.

At times, to increase the range of motion taking the body part to the extreme elongation of the muscle and having the person push or pull firmly. On the relaxation of the muscle then stretching it farther can increase the range of motion. Traction and approximation of joints can be used to stimulate the proprioceptive centers that are found in the joint structures. Approximation can be a useful stimulus to stimulate postural reflexes. For example, to aid in correcting sitting imbalances, a sudden pressure can be applied downward over the shoulders. The patient is told to hold their position upright preventing rotation of the trunk. The pressure is applied anteriorly on one shoulder and posteriorly on the other and then alternated. This can also be done with the patient standing bracing themselves with their hands on their pelvis pressure is applied again through the pelvis by applying pressure on the patient's hands that are on the iliac crest. The treatment can also be done while the person is walking. In singular joints traction or approximation that alters the and normalizes the muscle response should be made through a range of motion

The term irradiation was used before. This refers to reinforcing normal muscle contraction in under functioning joints. This can be accomplished by having the patient perform maximal contraction proximally or distally while the under-functioning portion is taken through its normal range of motion. For example, in problems in the wrist and hand, the upper arm would be blocked having the patient exert maximum contraction of flexion and extension pattern while the patient flexes and extends the wrist.

Proprioceptive Neuromuscular Inhibition

Goodheart first referred to this phenomenon as a reactive muscle. The more appropriate term would be proprioceptive neuromuscular inhibition.

The reactive pattern refers to the inhibition of a muscle following testing of another muscle.

The basic premise here is that one synergistic muscle is over contracting to create the abnormal inhibition of another muscle.

If this is suspected, question the person about the physical activity that they're doing when they experience either inhibition, ache or pain. Asked them to point to the area of discomfort and analyze what the prime movers to perform the task are. These are the primary muscles that are involved in this pattern.

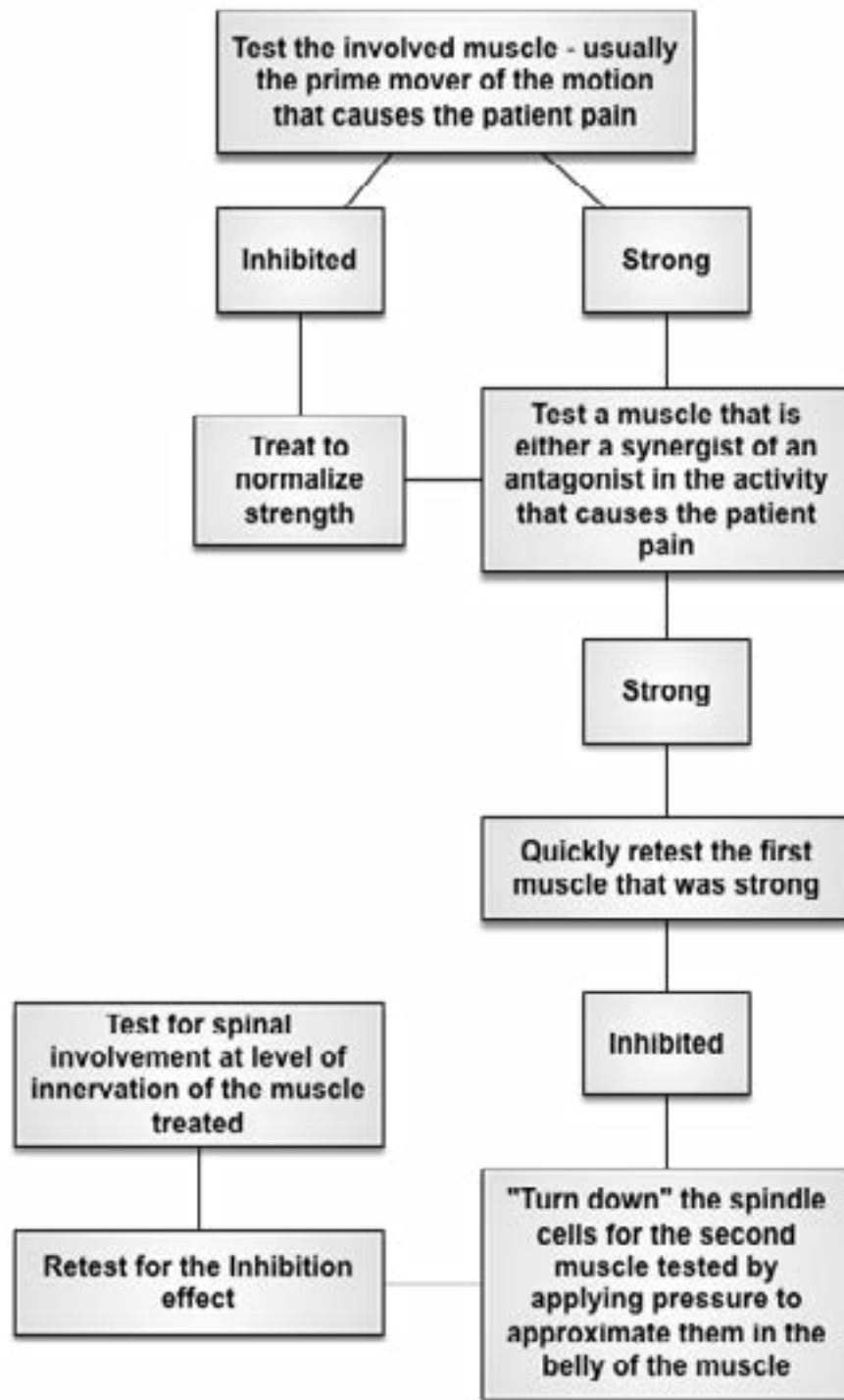
This inhibition occurs because of improper proprioceptor communication between the related muscles. A suspected muscle is tested to determine if it is normally functioning. If the muscle is found to be inhibited, treat it in the usual fashion. Test a related functioning muscle. Most commonly this is a synergist to the original muscle, and then quickly retest the original muscle.

If the inhibition pattern is present, the original muscle will now be inhibited.

Treat the spindle cells of the muscle that when tested caused the inhibition of the original muscle. The spindle cells are stimulated as if to inhibit the muscle. Imagine that the muscle is set too strong and therefore overpowers the other muscle creating the inhibition.

Retest the muscle testing sequence to make sure that the muscle test normal after treating the spindle cell.

One of the problems is that the muscle that is causing the inhibition can be at a far distance to the one that becomes inhibited. This is frequent in sports applications. In these cases, you need to look at the whole muscle firing sequence of how a specific task is performed. Many of these will be discussed in future books in this sequence.



Another problem that can be encountered is when a patient has decreased range of motion. In this case and antagonistic muscle may fail to be inhibited by the contraction of the prime mover. This condition can occur either because the muscle fails to fire correctly or that it is firing but not firing fully.

At one of the annual meeting of ICAK in the 1980's, Deal presented the idea that a muscle could be "frozen." In effect, the muscle would not be inhibited by contraction of its antagonist the prime mover.

This condition leads to a loss of range of motion due to the failure of the antagonist muscle to relax.

The indication for this is a decrease in range of motion when the involvement of adhesions and inhibition of the prime mover have been eliminated.

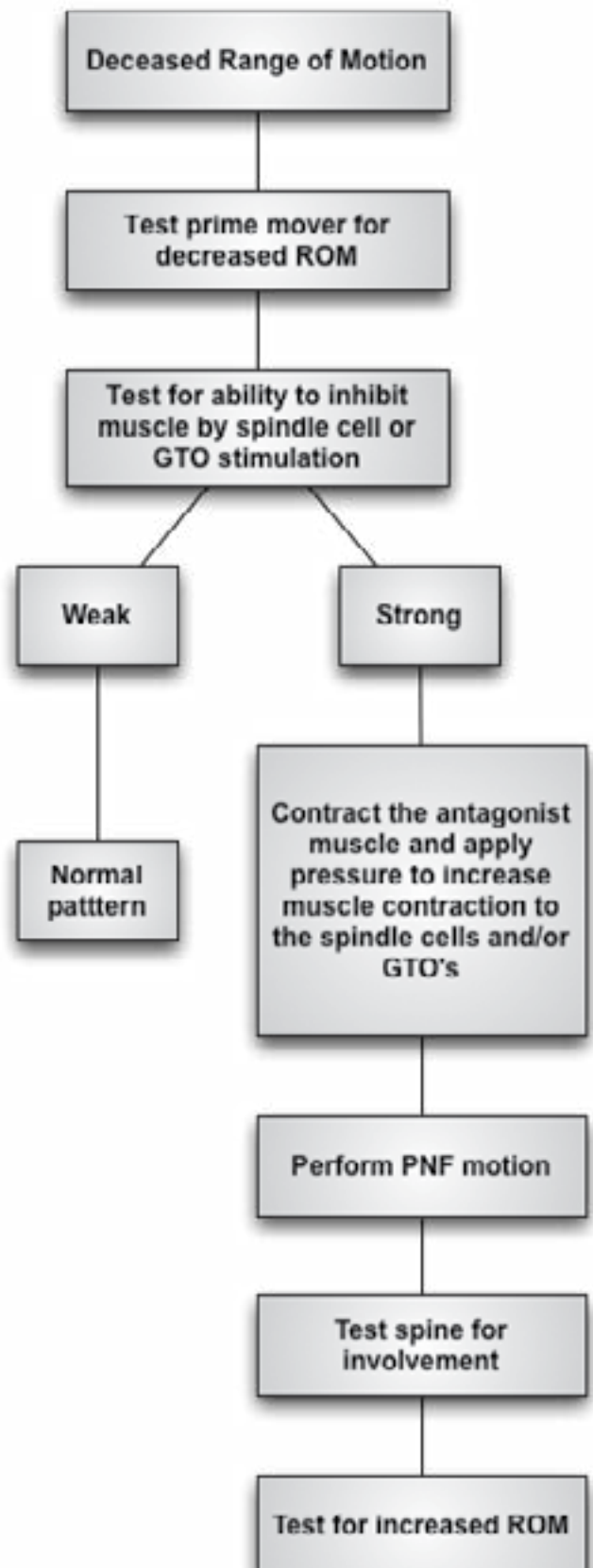
Block the patient so that they can contract the prime moving muscles continually for a period of three to five seconds. While the patient is contracting the muscle maximally, pull apart on the spindle cells to set the contraction stronger.

After this is done, have the patient move the extremity and then retest the range of motion.

You will usually find a dramatic increase in the range of motion.

As the patient contracts the prime mover, the antagonists are told to relax by the contraction of the prime mover. This allows the increased range of motion.

This should be followed by having the patient make a PNF motion for 10 to 20 cycles.



Joints - Ligaments

In an injury to a joint, the ligaments can become stretched and damaged. In this case a related muscle that supports the joint can become inhibited.

The inhibition of the muscle may be corrected by reducing the stretching of the ligament.

A common example of this is in pelvic lifting injuries. The sacroiliac ligaments become injured and the gluteus maximus muscle becomes inhibited.

This is an example where support to the joint approximating the ligament results in normalizing the function of the muscle.

In cases where trauma has been done to a joint and there is a local inhibition of a muscle, especially if it does not normalize with other treatments, suspect that the ligament stretching is causing the inhibition.

Approximate the joint, reducing stress on the ligament and retest for normalization of function in the inhibited muscle.

Supporting the joint with either a brace or taping may be needed for a positive outcome.

Skin - Scars

Skin is the largest organ of the body. Proprioceptors in the skin tell us where our joints are and are involved in the inhibition of muscular activity.

Cutaneous receptors in the skin can alter muscle function of the skin when it is traumatized or stretched. For example, when you bend the knee and stretch the skin over the patella, there is usually a reflex inhibition of the quadriceps. This reaction is temporary and can easily be overpowered and occurs only for a very short period of time.

A common example of this is in the strain/sprain of an ankle. Generally, the skin over the lateral aspect of the foot and ankle becomes stretched and testing of the peroneus tertius will usually find this muscle inhibited.

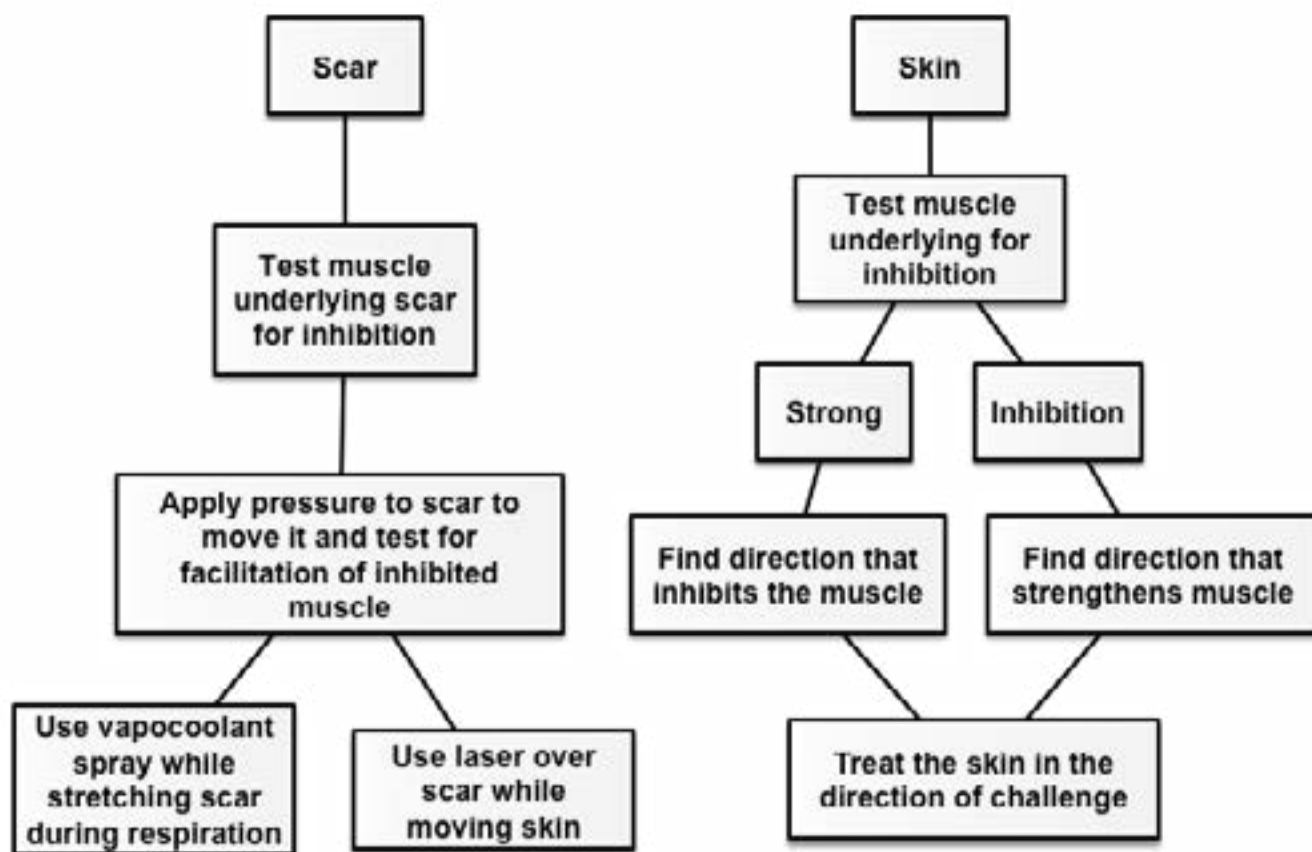
To demonstrate this phenomenon, test and find a normal functioning latissimus dorsi. Take your fingers and stretch the skin over the lateral aspect of the scapula as would happen when you are raising your arm. If you quickly test the latissimus after stretching the skin, you will find it now inhibited. This reaction occurs for very short period time. In cases of falls when the skin is injured, the inhibition can last for long periods of time.

Imbalances in these receptors create muscular imbalances that lead to the continuation of many structural pain patterns.

Treatment consists of finding the direction of tugging that inactivates the inhibition, and then treating in the exact opposite direction.

Scars can also cause inhibition of the muscles that underlie this scar. In general, all scars should be tested for this inhibition pattern. Many times, you will find movement of the skin when you apply pressure to the scar. The best procedure however is to test the underlying muscle or the muscle that would be affected by stretching of the skin. If the muscle is found to be inhibited move the scar by applying light pressure in different directions. Every testing the muscle finds a positive response and the scars involved. Treatment can be accomplished in a number of ways. You can apply directional force as to move and stress scar, laser application over the scar with body movement is another or electrical stimulation or needling of the scar have also been effective. The original technique that Goodheart used involved Springs car with a vapor coolant spray while stretching the scar.

It should be noted that the tendency is for the scar to become involved over time. The patient should be instructed to continue the treatment at home for a minimum of 10 days and then periodically, for example, once a month to repeat the treatment for a day or two. Testing, many times, shows that the scar involvement returns over time.





Skin Treatment

The picture to the left shows a scar over the patella.

If the quadriceps is inhibited, ask the person to pull and apply pressure in different directions to see if it causes any increase in strength of the muscle. If this occurs, treat the scar



This picture shows directional pressure applying stress to the skin over the lateral aspect of the ankle. Testing of the peroneus tertius is evaluated during the tests.



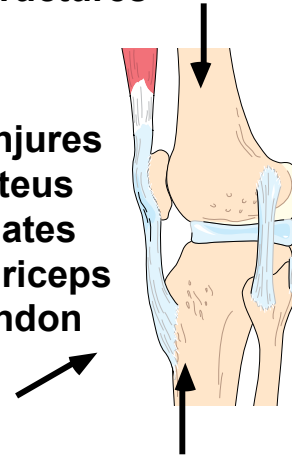
In this picture, a cold laser is being used over a scar while directional pressure is used to move the scar.

Shearing vs. Compaction Type Injuries

Traumatic injuries tend to occur in two types. The first is a shearing type of injury. These are the most common. They happen when the joints and related structures are strained and twisted causing damage to muscles, ligaments, skin and the proprioceptors of the joints. The classical examples of these types of injuries would be a sprained ankle, a whiplash injury to the cervical spine or the person who bends over to pick up an object and feels a snapping in their back. These types of injuries require treatment to all of the injured structures for rapid recovery. Consequently, joint mobilization (manipulation), muscle, ligament and skin proprioceptive procedures are needed. The second type of injury is the compaction type. In this injury, the person falls to the ground and breaks the fall with the arm, holds the steering wheel with straight arms at impact, or jumps down and lands with locked knees. In these cases, there is little to no tearing of tissues and swelling, if present, is limited to the joint capsule.

**Compression injuries
the joint structures**

**Shearing injures
Popliteus
Cruciates
Quadriceps
tendon**

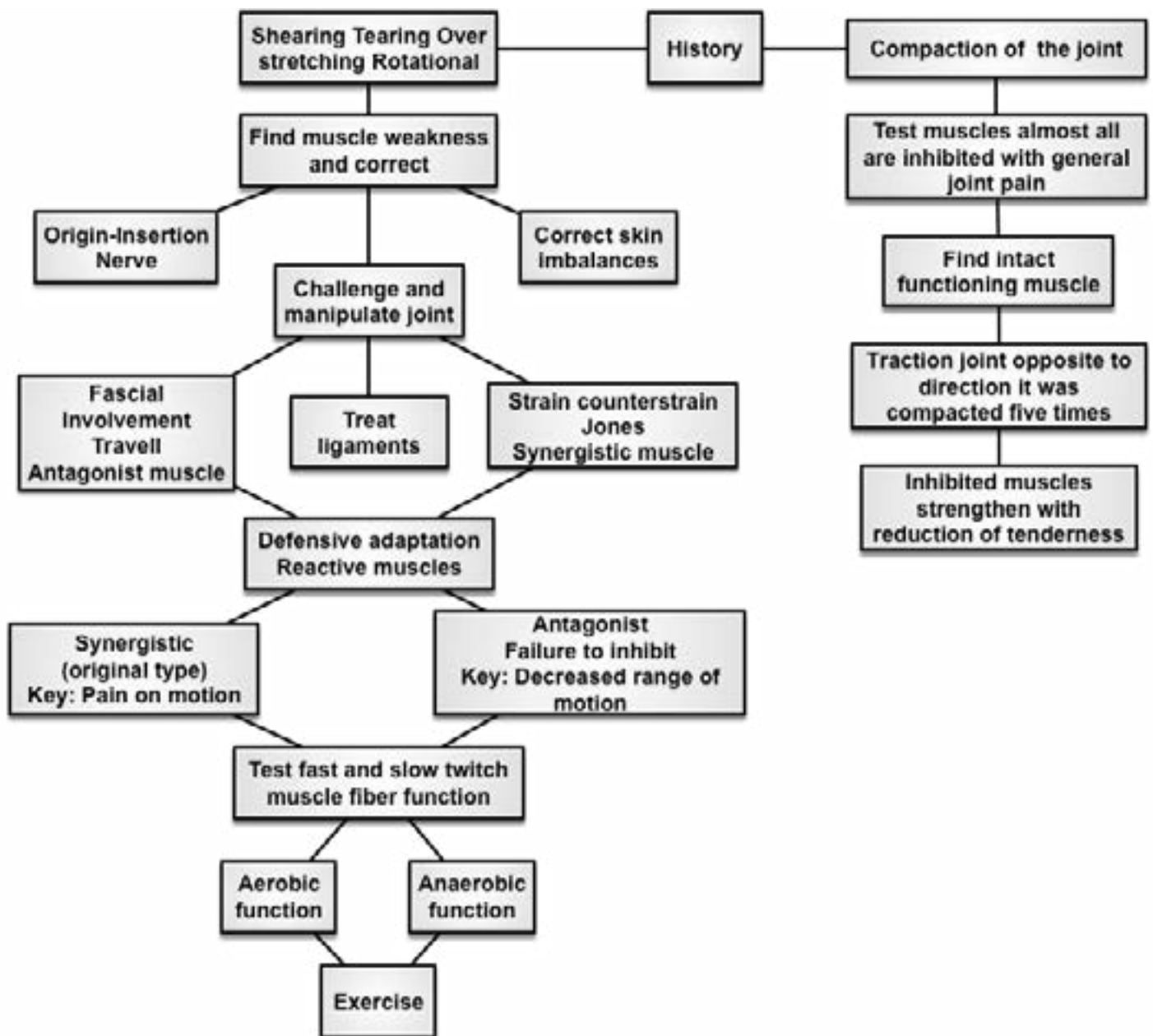


In the shearing injury, you will find the trilogy of an inhibited muscle, a synergistic muscle that exhibits tenderness to palpation and the need for strain counterstrain and an antagonist to the inhibited muscle that tests for the need of the Travell fascial procedures. These findings form the basis of the treatment that is needed.

When the inhibition pattern or the initial injury strains the ligaments, residual pain over the ligaments will be found.

In the compaction type of injury, the presenting findings are marked inhibition of almost all muscles surrounding the joint. One or two muscles will test normal. Further testing will show that the “intact” muscle will inhibit to repeated muscle testing. Hypothetically, the continued contraction of this muscle strains the attachments of the muscle so that upon repeated use of the muscle in its normal range of activity will result in an inhibition effect. Treatment is then directed to the origin and insertion of this muscle. The pain associated with this type of treatment can be dramatically reduced by placing the involved muscle in its shortened position while performing a circular massage over the myotendinous areas.

In the compaction type of injury, the trauma is directed mostly to the joint itself. The stress effects mechanoreceptors and nociceptors in the joint structures. Biedert, Stauffer, and Friederich investigated the occurrence of free nerve endings in the knee joint. They found that the density of type IV free nerve endings (nociceptors) was highest in the medial and lateral retinacula and the patellar ligaments. They concluded that the presence of these proprioceptive fibers is essential in the active control of the patella and the rotation of the tibia and that injury to the mechanoreceptors found inside the joint capsule, especially the anterior cruciate ligament, results in knee instability. Repeated joint distraction apparently normalizes the afferent discharge of these articular receptors reestablishing the normal tonus of the muscles.



Integration of Therapies

Integrating muscle therapies starts with a proper history. Injuries occur that involve tearing compression and history gives you an idea of the type therapies are going to be needed. An injury like a fall or reaching for an object and pulling on it, for example, falling off a bicycle you're going to have an injury to not only the muscle, joint, ligaments, and skin. All of these have to be taken into account. As was mentioned earlier if you compress a joint is and falling straight on your arm you will many times find all the muscles around the joint will be inhibited and there will be tenderness and pain when the joint is palpated. This is similar to jamming your thumb it hurts you grab it you traction it, and it feels better you instinctively do this.

In chronic injuries, the person will many times present with ache and soreness in muscles that have the trigger points. Always as the patient to point to where they feel discomfort. For example, the patient raises their arm in approximately hundred and 20° they say they feel tenderness and soreness and point to a muscle it hurts here usually that is not the inhibited weak muscle. This is usually a synergist trying to overwork, and sometimes it's antagonist.

In general, you will find that synergist muscles will tend to fall into the strain counter strain problem that Jones described. Antagonistic muscles tend to fall into the pattern of the travail fashion involvements. Testing whether by doing the test described in the sections before or by palpating and seeing if the tenderness reduced by either stretching or shortening the muscles gives you an idea of how to find the weak inhibited muscle.

Therapy begins typically by trying to normalize the function of the inhibited muscle. If there's trauma involved the original technique that Goodheart described as origin insertion is usually employed. If this problem is been there for any length of time, you will find the strain counter strain in the fascial involvements both need to be treated.

The tissues in the area of the injury once these three prior problems of been corrected need to be palpated and pressure applied at 90° to see if any cross-links or protein bonds need to be freed. How you free these is up to you. You can use a machine like a precursor or do manual therapy.

After this range of motion and muscle coordination need to be considered this is where you enter into the PNF type procedures. There are two ways of approaching this.

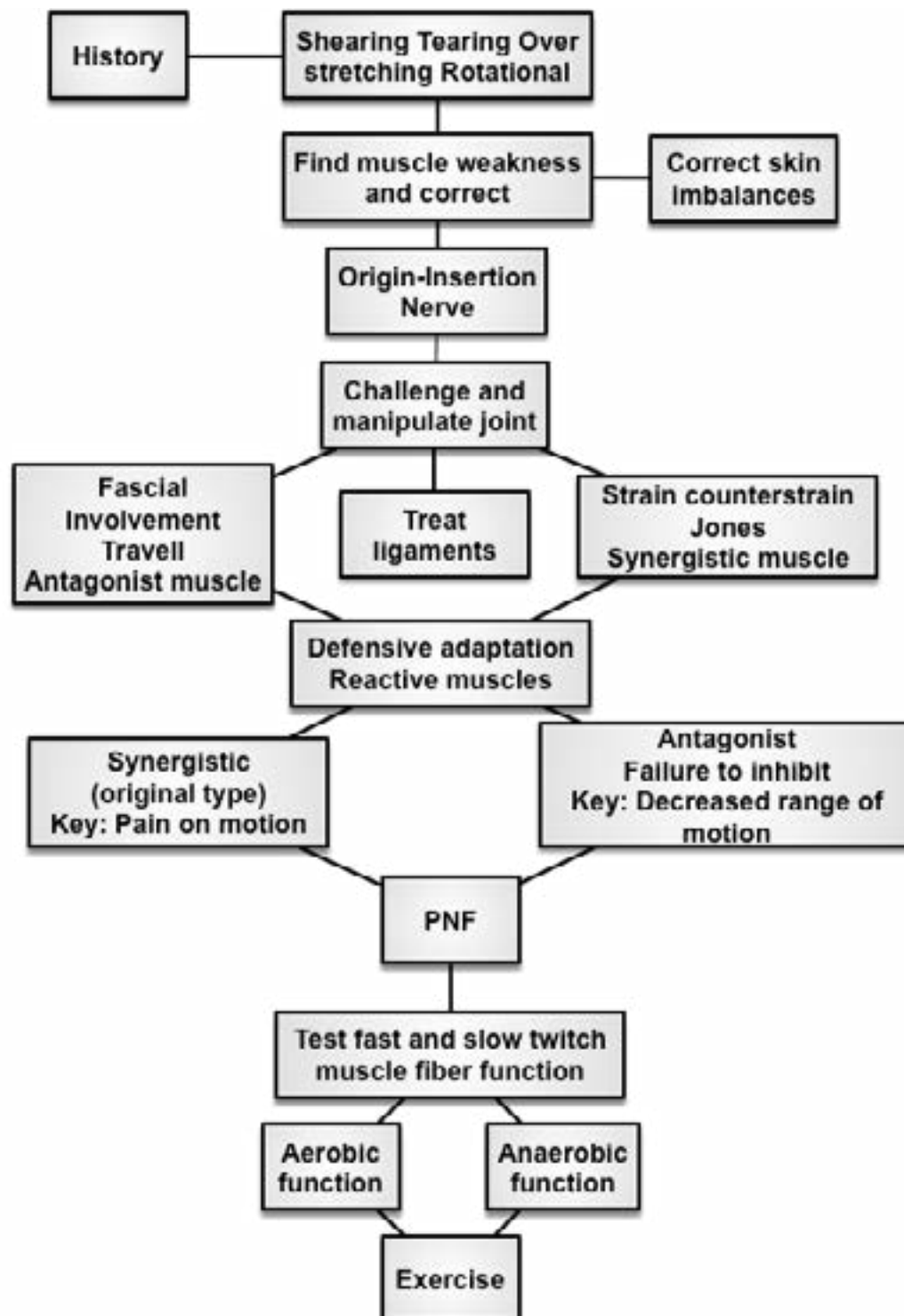
You can examine on an individual basis testing for improper inhibition of muscles by the contraction of the prime mover and doing the spindle cell correction the Goodheart advocated. The alternative to this is to do the PNF type movements that have been advocated for years. In this, you will do a restrictive movement in the X as was described and to speed this up for cause in the area of the joint. Many times, athletic trainers are told that you have to do the PNF movements for up to 20 minutes to get results. This can be dramatically shortened to 2:58 with the application of the precursor in the area while the movements are being performed. This procedure usually normalizes the proprioceptive function between the agonist and antagonist of muscles.

Once for range of motion has been attained the next step is to test for anaerobic and aerobic function of the involved muscles and using that information to set an appropriate rehabilitation program for the person.

Many injuries will cause alterations in standard walking pattern of patients. Years ago the author was confronted with a marathon runner who had been to five rehabilitation centers in Europe for pain in the abductors. After a very short run, he would get severe pain in his abductor and could not train. In examining his walking pattern, he failed to move the opposite shoulder. When asked about it he said that he had fallen skiing on that shoulder a week before he got the pain in the opposite adductor. In normal body motion, the opposing arm and leg work in a coordinated fashion. Treatment was rendered to the injured shoulder, and the patient was asked to exaggerate shoulder motion while walking and running. He immediately reported that the pain was gone in the adductor.

Many patients adopt their injuries and change how they walk. The goal with the patient is to get them to walk and moving in a healthy coordinated fashion.

As has been stated before, different body parts will be addressed in following books in the series. In all of these, proper testing of muscles and the muscle, treatment procedures talked about in these last few chapters and a few others will be presented in integrated together the goal here is to make you a better practitioner and healer.



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Diagrams were done using Poser, Daz, Photoshop and Illustrator

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